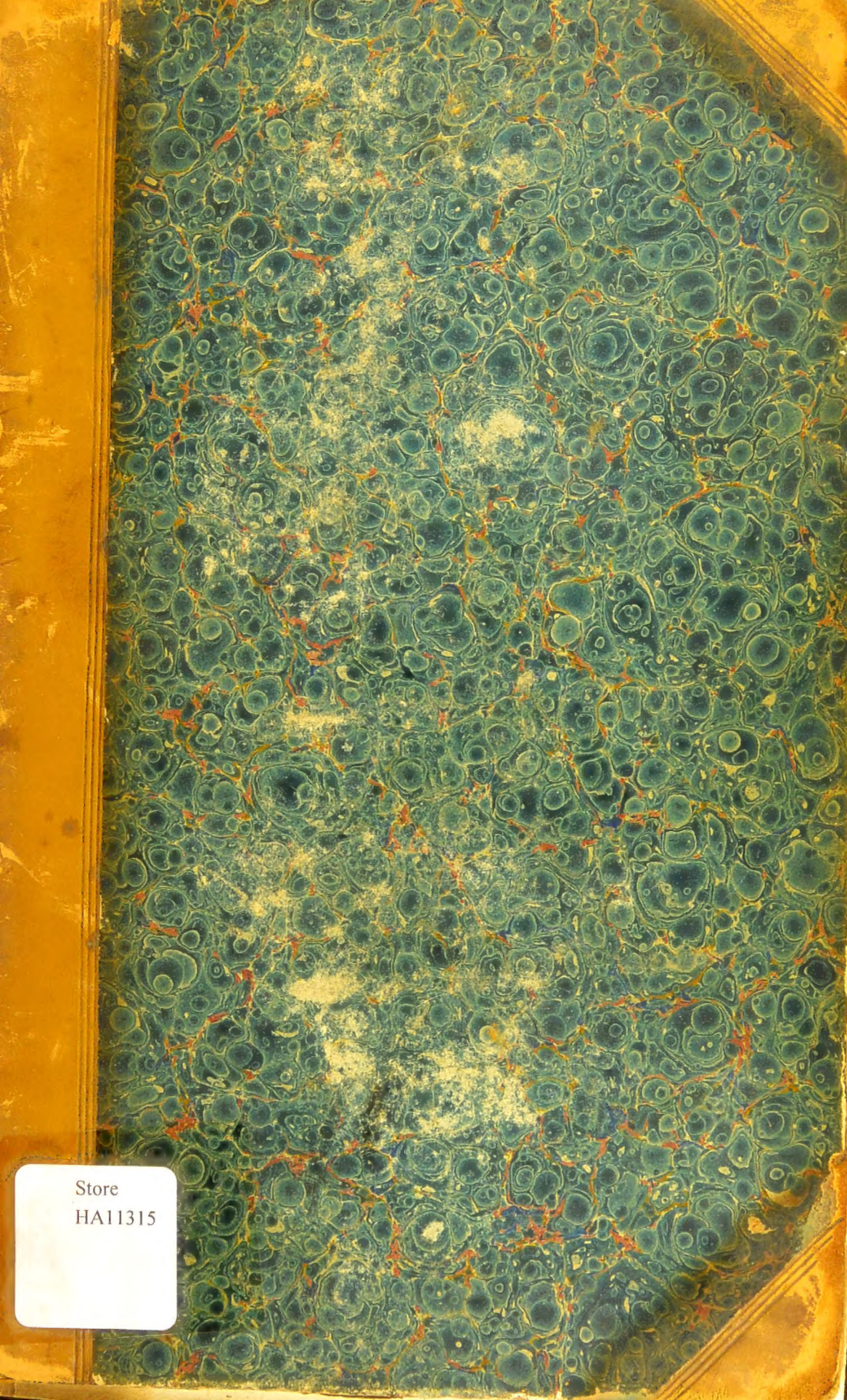


The image shows the front cover of an antique book. The cover is decorated with a traditional marbled paper pattern, specifically a 'stone' or 'shell' pattern, featuring swirling, cell-like shapes in various shades of green, blue, and brown. The marbling is dense and covers most of the surface. A wide, gold-tooled border is visible along the edges of the cover, showing signs of wear and age. In the bottom-left corner, there is a small, white, rectangular label with black text. The overall appearance is that of a well-used, historical volume.

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ELEMENTS
OF
MATERIA MEDICA
AND
THERAPEUTICS;

INCLUDING

THE RECENT DISCOVERIES AND ANALYSES OF MEDICINES.

BY

ANTHONY TODD THOMSON, M.D. F.L.S. AND G.S.

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JURISPRUDENCE IN THE UNIVERSITY OF LONDON, MEMBER OF
THE ROYAL COLLEGE OF PHYSICIANS, ETC. ETC.

VOL. I.

LONDON:

LONGMAN, REES, ORME, BROWN, GREEN, AND LONGMAN,
PATERNOSTER ROW,
AND
JOHN TAYLOR, UPPER GOWER STREET.

MDCCCXXXII.

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ELEMENTS

MATERIA MEDICA

AND

THERAPEUTICS

THE FIRST, SECOND, AND THIRD EDITIONS

BY JOHN THOMSON, M.D. F.R.S. AND F.R.C.

WITH A NEW EDITION OF THE THERAPEUTICS, AND A NEW EDITION OF THE MATERIA MEDICA, AND A NEW EDITION OF THE ELEMENTS.

39
27

PRINTED BY J. MALLETT,
59, WARDOUR STREET, SOHO.

TO
WILLIAM BABINGTON, M.D. F.R.S. -
FELLOW OF THE ROYAL COLLEGE OF PHYSICIANS OF LONDON,
WHOSE HAPPILY PROTRACTED LIFE
OF
ACTIVE AND USEFUL PROFESSIONAL EXERTION,
ADORNED BY
A GENUINE LOVE OF SCIENCE
AND AN
UNABATED ARDOUR FOR THE ACQUISITION OF KNOWLEDGE,
UNITED WITH THE
MOST AMIABLE MANNERS AND UNSULLIED CHARACTER,
EXHIBITS THE
PERFECT MODEL OF A SCIENTIFIC PHYSICIAN,
THIS WORK,
COMPILED FOR THE USE OF
THE STUDENT AND THE JUNIOR PRACTITIONER,
IS INSCRIBED,
AS A TRIBUTE OF ADMIRATION, RESPECT,
AND
FRIENDSHIP.

WILLIAM HARRINGTON, M.D. F.R.S.

LECTURE ON THE HISTORY OF THE SCIENCE OF LIFE

WHICH WERE DELIVERED AT THE

OF

THE ROYAL SOCIETY OF LONDON

AND

A SERIES OF LECTURES ON

AND

THE HISTORY OF THE SCIENCE OF LIFE

DELIVERED AT THE

ROYAL SOCIETY OF LONDON

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THE HISTORY OF THE SCIENCE OF LIFE

PREFACE.

THE intention of the following pages is to present a condensed view of the branch of medical science of which they treat. The extent and nature of the subject has been too little considered, and the preliminary acquisitions requisite for its proper acquirement most unaccountably overlooked, in the course of studies prescribed by the incorporated medical bodies in this country. Instead of commencing his medical education by attending lectures on *Materia Medica*, which is an obligation imposed upon him by the existing regulations, the student should previously attend, at least, one course of Natural History, Botany, Chemistry, Anatomy, and Physiology; and not till then can he be expected to comprehend the doctrines delivered in a course of *Materia Medica*, far less those relating to Therapeutics. The Author flatters himself that the contents of the following pages will render evident this mistake in medical education; and, consequently, effect its correction.

The Author has adopted that arrangement of his subject which he thinks the best calculated to make the work useful, both to the student and the junior practitioner; and, by collecting in one point of view all the discoveries with which modern Chemistry has enriched the field of *Materia Medica*, and those practical facts which clinical medicine has furnished for elucidating the doctrines of Therapeutics, he hopes that it may not be considered unworthy of the attention of the experienced practitioner. He has lost no opportunity of availing himself of the labours of the Continental Chemists

and Medical Writers, as well as those of our own country, and our transatlantic brethren. He has, indeed, had recourse to every original source of information within his reach ; and he trusts that the composition of the work will demonstrate that his diligence has not been misapplied.

Although the greatest portion of the work can be regarded only as a compilation, yet, the Author has introduced into its pages the results of thirty years of attentive and close observation in the treatment of diseases. With an enthusiastic love and a veneration for his profession, which he is anxious to impress upon those who are commencing the study of its principles, he has endeavoured to trace the nature and the phenomena of morbid action, and to ascertain the actual influence exerted by remedial agents in effecting its removal. What he has observed he has faithfully recorded ; and he has distinguished, as far as his experience has enabled him to verify the statements of others, facts from conjectures, and truth from misrepresentation. Still, however, the ample field of *Materia Medica* remains imperfectly cultivated : if the following pages only excite those calculated to draw forth the riches of the soil to lend their aid to the task, the Author will rest satisfied with the result of his exertions.

3, *Hinde Street, Manchester Square,*

25th September, 1832.

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CORRIGENDA.

Page 35, heading, for MEDICAL read MEDICINAL.

— 11, line 21, dele "a."

— 13, — 2, for "depend" read "depends."

— 592, — 10, from bottom, for TOXICONDENDRON read TOXICODENDRON.

ELEMENTS

OF

MATERIA MEDICA AND THERAPEUTICS.

PART I.

SECTION I.

DEFINITIONS.—MEDICAL AGENTS:—GENERAL CIRCUMSTANCES
CONNECTED WITH THEIR ACTION ON THE LIVING BODY.

MATERIA MEDICA is that branch of the Medical Science which relates to Medicines. It comprehends a knowledge of these agents, whether in their natural state, or, as compositions, the production of the pharmaceutical art: and, also, of the physiological effects which their administration produces on the living body. *Therapeutics* is a knowledge of those phenomena of the animal body which follow the administration of medicines, and precede the restoration of health.

Medicines are substances capable of exciting actions in the living system, and causing changes in its condition sufficient to overcome any unnatural state of one or more of its functions, which may constitute disease; and, thence, they are calculated to favour the return of health. Their influence, although not altogether dependent on the morbid state of the habit, yet, is greatly modified by it: that which agitates in health may soothe in disease. They are derived from both the *organic* and the *inorganic* kingdoms of Nature. The greatest number are vegetable substances; those of an animal and a mineral origin are comparatively few.

Those medicines which are of an animal and a vegetable nature differ from food in containing some active principle not adapted to repair the waste of the body. The other components of the animal or the plant, such as albuminous, gelatinous, saccharine, and oleaginous matters, fecula, and gum, submit to the digestive powers; but the medicinal principle resists these and often governs them. The medicinal properties, however, of organic bodies, are not the same at every period of their existence. In animal bodies they are often developed or rendered more active during the exercise of some peculiar function, as, for instance, that of copulation in *Cantharides*: among vegetables also, many which possess active medicinal properties when they have attained their full growth and are capable of exercising their reproductive faculties, may be freely eaten when young: thence the necessity of attending to those circumstances which modify the influence of animal and vegetable substances as remedial agents. The medicinal influence of mineral substances is always the same, the circumstances of the habit under which they are administered being equal: they are, in general, more active, and admit of a greater diversity of combination and pharmaceutical composition than either animal or vegetable matters.

Medicines operate only on the living body: indeed, they may be regarded merely as means of affecting the vitality of the animal solid, whether that exhibit itself under the phenomena of *contractility*, *irritability*, or *sensibility*. To produce their effects, they must be in immediate contact with some part of the body, either the external surface, or some of the internal cavities communicating with it: as a preliminary step, therefore, to an enquiry into the objects of the *Materia Medica*, it is requisite to obtain correct ideas respecting the general manner in which medicinal agents operate on the living body; and, also, a knowledge of those states of the habit, constituting *health* and *disease*, by which their operation is greatly modified. Thence the intimate connection between *Materia Medica* and *Therapeutics*, the end and object of its investigations.

Health is that condition of the body, in reference both to

its component matter and its functions, which enables it not only to preserve its integrity, as a whole and in all its parts, but, also, to resist the impulses of many external agents; and to assimilate and appropriate to its own nature things foreign to itself. But besides this harmony and equilibrium in the physical part of the system, it is also essential, in order to constitute perfect health, that the mind should be as sound as the body. It would be out of place, in this work, to venture upon metaphysical ground; either to maintain or to deny, that the mind is simply the functional power of the brain; or a distinct Divine essence: neither is it necessary for me to endeavour to explain how the body is affected by the mind, or the mind by the condition of the body. For our purpose, it is sufficient to know that the healthy condition of each is reciprocally affected by the state of either: the harmony and equilibrium of both in the same person, therefore, constitute health. But as the condition termed health, necessarily differs according to age, sex, mode of life, custom, and other circumstances, these variations must be kept in view. Thus, for example, in determining the health of a young unmarried female, who has once menstruated, the regular appearance of the catamenia must be taken into account: but in a woman who is suckling, or who is beyond a certain age, this is not one of the indications of health. In the healthful state of the habit, many substances, justly regarded as medicinal, may be digested, and some part of them undergo the process of assimilation: and as the stomach is, in this state, an active organ, it is capable of resisting the influence of many medicines, which would operate powerfully upon it in the opposite state, which is that of disease.

Disease is that condition of the body in which its vitality is either so diminished or impaired, that some, at least, of both the animal and vital functions are imperfectly performed. The vitality of the stomach, in particular, is diminished, and the organ rendered incapable of resisting the action of extraneous bodies; consequently, the whole of the digestive viscera become unfitted to perform, perfectly, their functions. In affirming that vitality is diminished or impaired, it must

not be supposed that any change takes place in the principle of vitality ; on the contrary, this continues the same ; but the organs, in a diseased state of the body, are less sustained by its influence. Substances, therefore, taken into the stomach, in this state of the habit, instead of being properly digested, undergo the changes that they would suffer, *cæteris paribus*, out of the body, and obey those laws which regulate the chemical affinities of their components : at least, such is the case, in a great degree. As the system, therefore, cannot, in this condition, resist the influences of common matter acting by its own laws ; the power which, as it were, holds the different parts of the body together, gives way, and, at length, it becomes the victim of the ordinary laws of the affinity of its components, or, in familiar language, death ensues. In the state of disease, the stomach consequently ceases to be an active organ ; for, as a part of the living system, it is governed by the same laws ; and, like the rest of the system, the weaker it is, the more it is placed under the influence of physical agents : and many substances received into it, operate as medicinal agents, which would be resisted in a state of health. The stomach, in truth, is in a condition which may be termed *active* in health, and *passive* in disease ; and, consequently, it is variously affected by the same substances in these different conditions. A reference, however, to the morbid state of the body is not essential to constitute any substance a medicine ; for, although many substances apparently do not affect the *healthy* stomach in the ordinary doses in which they are exhibited as remedies in disease, yet, there is no substance which deserves the name of medicine, that does not, in larger doses, more or less, make some impression upon that organ in health. On the contrary, a substance, which is easily decomposed by the process of digestion, is not very likely to operate medicinally, unless we suppose that decomposition occurs, and new combinations of its components take place, and that the products become active medicines ; a manner of reasoning purely hypothetical. If we adhere to facts, we shall find that substances which fully undergo digestion, rarely, if ever, operate as medicines. This conclusion is not necessarily at variance

with the statement, that a substance may be partially digested, and yet exert a medicinal influence upon the body. Indeed, as Cullen justly remarks, “with respect to vegetables, and also some animal substances, it is often a certain portion of them only that can be subjected to our digestive organs, while the medicinal part of the same is hardly affected; and, therefore, it may be alleged, that their operation on the interior parts is not prevented by the powers of digestion.”* To illustrate this by an example, let us suppose that a substance is swallowed, which consists of a very active medicine involved in a large quantity of mucilaginous or of amylaceous matter: the latter undergoes the action of the digestive process, and the active principle, being set free, exerts its full influence upon the stomach, and, through it, upon the rest of the habit. Such is probably the exact state of the case, when the bulb of the *Colchicum autumnale*, which contains *Veratria*, a very powerful medicine, involved in a large quantity of farinaceous matter, is administered in the form of powder. Upon every view of the question, we arrive at this conclusion—that, although the digestive function interferes more or less with the operation of medicines taken into the stomach, and the action of every medicinal agent is modified by the peculiar state of this viscus at the time when it is taken, yet, we cannot strictly affirm that a medicine is either digested or assimilated. Having settled this point, and understanding by the term “Medicine,” a substance which is capable of altering the state of the body, whether in health or in disease; we have next to enquire in what manner medicinal agents operate upon the living body?

There are five distinct modes in which medicines act upon the living body: 1. they may act by a direct impression upon the surface to which they are applied, the effect being confined to the part: 2. by an impression upon the nervous energy of the surface to which they are applied, and the effect be extended to the other parts of the system: 3. they may be conveyed by absorption, undecomposed, into the system, and influence the habit through the medium of the circula-

* Treatise on the Materia Medica, 2 vols. 4to.

tion: 4. they may be decomposed and operate only by one or more of their constituents: 5. they may operate by counter irritation or revulsion.

DIRECT ACTION OF MEDICINES.

When a medicine is taken into the stomach, or is applied to any part of the living surface, its direct and sole operation may be confined to a physical change impressed on the tissue of the organ; and, although the function of the part, if weakened, be thus restored to a state of healthful energy, and the entire system benefited by the change, yet, the influence of the medicine can only be regarded as strictly affecting the condition of the vital surface to which it is applied. This mode of action is well illustrated in the influence which astringents, either taken into the stomach or injected into the rectum, exert in checking diarrhœa depending on a merely relaxed state of the intestinal canal; and in the effect of collyria applied to a blood-shot eye. It is the simplest mode of medicinal action.

ACTION OF MEDICINES ON THE NERVOUS ENERGY.

A medicine may act directly upon the nervous energy* of the part to which it is applied, and the effect produced there be extended to the other parts of the system.

It has long been admitted, that medicines acting on the stomach have their influence extended to the whole of the system; that they act upon the sensible and irritable parts of the stomach; and that it is only upon this supposition that we can account for the sudden changes which are produced upon distant organs and parts of the body, soon after a medicine has been introduced into the stomach: an impression is made

* Nervous energy is that power inherent in the nervous system, including the brain and the spinal marrow, which renders the body susceptible of impressions both mental and material.

upon one organ, and extends quickly over the whole body. How is this to be explained?

That every medicine operates either directly or indirectly upon the nervous system can scarcely be denied. When a medicine is absorbed and taken into the circulation, we are unable to prove that any chemical change is effected in the circulating mass by it; and, even were this the case, still we must refer its ultimate effect to some action upon the nervous system, unless we suppose that the secretions are mere chemical changes in the fluids, altogether independent of the vital principle, an idea which is totally devoid of support. Chemical changes, also, in the fluids can be more readily explained, on the supposition that, a new action being excited in the organ or organs secreting the fluids, the result will be a change in the nature or the proportion of the components of these fluids, than that the medicine penetrates the vessels and acts chemically upon their contents. It is true that many medicines enter the blood vessels, and, being conveyed to various organs, these are excited in the same direct manner as the surface to which the medicines were first applied: but, at the same time, phenomena occur which can only be referred to nervous sympathy.

If we admit the principle that medicines can only affect the body through the medium of the nerves, that is, as far as regards their operation beyond the stomach or the part to which they are directly applied, there is no difficulty in understanding the manner in which the impression is propagated over the entire system, or to some organ perhaps the most distant from that which has received the immediate impression of the medicine. The Physiological discoveries of Sir Charles Bell* have so far unravelled the intricacies of the nervous system as to enable us to comprehend how impressions are communicated along certain sets of nerves, while other sets remain inactive; and, thence, to understand those associated changes which almost simultaneously occur in distant parts. From his investigations

* An Exposition of the Nerves, &c. 8vo.

we learn that all the nerves of sensation communicate by originating in the same medullary tract, in the spinal marrow and brain ; that a similar medium of communication unites the nerves of motion or volition, and a third also those of respiration. Now, if an impression be made on any portion of one of these sets of nerves, it is communicated to the whole set to which the affected nerve belongs, by the common medium which conjoins them. Thus, if a violent pain be felt in the great toe, as occurs frequently in gout, it may be allayed by a large dose of Opium taken into the stomach. We do not suppose it necessary that the Opium should be absorbed, and conveyed by the blood-vessels to the toe, in order to produce this effect ; the impression of the Opium is first received by the sentient extremities of the nerves of sensation of the stomach ; the new disposition given to them is propagated to the connecting tract in the spine, and the sensorium commune, and thence to the part which is suffering. It is not my intention to enter into any metaphysical discussion respecting the real seat of the sensation of pain, it is sufficient to state the fact, that, by affecting the sentient nerves of the stomach, the Opium allays a painful feeling depending upon a peculiar condition of the same set of nerves, in a distant part of the body. There is, then, a simultaneous action of some of the nerves in the most distant parts of the body ; indeed, it has never been doubted that those associated impressions, which we so often observe in disease, are to be referred to that simultaneous action. If this be a correct view of the subject, there is no reason why we should refuse to admit that the same power may regulate the operation of remedies. Let me state an example in illustration of this position. We are informed by a patient that he is suffering under palpitation of the heart ; we find, on laying our hand upon the region of the heart, that this organ is labouring violently, and is in the most irritable state ; and, yet, we can discover nothing which authorizes us to suppose that this disturbance depends, in any degree, upon organic disease or a change in the structure of the organ. We refer it, therefore, to the stomach, which we discover to be out of health, and we say, that the heart associates, or, in

other language, *sympathizes* with the morbid action of this viscus. No remedies are, in this case, administered with the view of *directly* influencing the heart; but those are prescribed which we know can correct the diseased condition of the stomach; and, as this organ becomes less irritable, the heart, also, becomes quieter, and recovers its healthy action.

But it may be properly demanded, what proof have we that medicines act through the medium of the nervous energy, independent of absorption? Many facts may be mentioned in support of this opinion; but two or three are sufficient to prove that it is correct. Rhubarb, when taken into the stomach, is in some way introduced into the circulation, and easily detected in the urine; we have, therefore, no difficulty in ascertaining whether it have been absorbed. Now, if we apply a poultice made with a strong decoction of Rhubarb, to the abdomen of a child, purging is excited; but the presence of the medicine cannot be detected in the urine by the most delicate tests. If the skin of the head be bathed with a strong decoction of Tobacco, vomiting will be produced; but no absorption of the decoction of Tobacco takes place. Indeed, many experiments, particularly those of Dr. Rousseau of Philadelphia, prove that the power of absorbing is limited to a very small portion only of the surface of the body: the space, for instance, between the middle of the thigh and the hip, and that between the middle of the arm and the shoulder. Proofs of a more direct kind may also be mentioned. M. Dupuy having divided the nerves of the eighth pair in a horse, two ounces of Nux-vomica, in the form of a bolus, were introduced into the stomach of the animal; no injurious consequences followed, although another horse, equal in size and strength to the former, to whom the same quantity of the poison was administered, died in a few hours in violent tetanic convulsions.

The rapidity, also, with which some medicines act when taken into the stomach, renders it, at least, doubtful whether their effects can be ascribed to absorption. Thus, if a drachm of Hydrocyanic acid be poured into the stomach of a dog, the influence of the poison is so instantaneous, that

10 ACTION OF MEDICINES ON THE NERVOUS ENERGY.

the poor animal sometimes dies before he can be placed on the ground from the knee of the person holding him. The poison of the Viper has proved fatal to a frog from whom the heart was cut out: but, in stating this, it must also be mentioned, that, in an experiment in which all nervous communication was destroyed, by severing the leg from the body of a dog, whilst the circulation was maintained by means of quills passing from the vessels of the body of the animal to those of the separated limb, poison introduced beneath the skin of the severed member produced all its effects upon the animal—a circumstance which can be referred only to absorption. Substances, also, which act powerfully when applied to the cuticle, as, for example, extract of Belladonna to the exterior of the eyelid, when it is desirable to dilate the pupil, prove narcotic if introduced into the stomach. In the first situation, we have no reason for thinking that the Belladonna is absorbed; and, in the second, although there is a probability that absorption may take place, yet the proofs of it are not more satisfactory. Upon the whole, there is abundant evidence that many medicines produce their effects by acting directly on the nervous energy, altogether independent of absorption. It is not essential that we should be able to demonstrate in what manner this communication with distant parts of the body is effected by the nerves; it is enough to know the fact, and we cannot proceed farther. The attempt to explain the phenomenon is as vain as that respecting the vital principle; we find ourselves out of our depth, and the struggle only convinces us that we are in an element which does not belong to us.

In whatever way this nervous communication is accomplished, there are three surfaces upon which the impressions can be advantageously made, and whence they are propagated:—the stomach and alimentary canal;—the skin;—and the organ of smelling.

1. The first of these, the stomach, is known to be a highly irritable organ, and amply furnished with nerves; whence the sympathy which exists between it and the other parts of the system, and the advantage of administering medicines through its medium. Few organs are more susceptible of

disease ; and, consequently, it is of the greatest importance to ascertain the exact state of the organ before administering any medicine. When labouring under diseased irritation, it is the centre of perceptions felt over the whole system, and is extremely susceptible of the impression of medicines ; whereas, in its healthy state, it resists them powerfully.

The most curious circumstance connected with the operation of medicines taken into the stomach, is the selection, as it were, by the medicine, of the part of the system on which it shall act : thus, a diuretic taken into the stomach, exerts its influence on the kidneys ; an expectorant, upon the mucous membrane lining the trachea and the bronchial tubes ; and a diaphoretic upon the skin.

The larger intestines, supplied with nerves connected with the great sympathetic, communicate the impressions of medicinal agents to the general system nearly in the same manner as the stomach, but with less energy : thence, larger doses of medicine and more acrid substances can be thrown into the rectum, with impunity, than into the stomach. Medicines, also, thrown into the rectum, operate, except in a degree, nearly in the same manner as those taken into the stomach.

2. The skin, the general integument of the body, is largely supplied with nerves and endowed with great sensibility ; and although the cuticle, devoid of sensation, is interposed between the true or sensitive skin and any substance applied to the surface, yet, the skin is readily excited, and communicates a sympathetic action to the rest of the system. Indeed, during many diseases, the skin is extremely sensitive : in hydrophobia, for instance, the sensibility is so great, that the smallest breath of air becomes a cause of uneasiness. That it is capable, therefore, of communicating impressions of medicinal agents is undoubted. We might again mention, in confirmation of this fact, the influence of Rhubarb and Tobacco, when applied to the surface : nothing is more easy than to demonstrate that no absorption occurs : and no medicinal agents applied to the surface of the body, when the cuticle is entire, except to a small portion of

the skin, are absorbed, but they exert their influence altogether through the medium of the nerves.

The 3d medium for receiving the impression of medicinal agents on the nervous system, is the organ of smelling. The effect is chiefly produced on the first and the fifth pairs of nerves distributed over the Schneiderian membrane lining the nostrils, the adjoining sinuses, and the convoluted bones so beautifully contrived to extend this surface in a limited space. Many odours cause nausea, vomiting, and rigors; and, therefore, it is not surprising that volatile medicines should effect the general system through the same medium. Many substances which are supposed to enter the system by pulmonary absorption, such as the fumes of Alcohol, Tobacco, and Ammonia, affect the habit solely by impressions made on the nerves of smelling. Dr. Rousseau of Philadelphia made numerous experiments upon this subject; he states, "that they warrant the conclusion that, by simply closing the nostrils, either by compressing them with the fingers, or by filling them up, the fumes of ardent spirits, or of a strong decoction of Tobacco, or an infusion of Opium, may be inhaled for an hour without any unpleasant effect; whereas, if the precaution mentioned be omitted, the consequences are proven to be most distressing." It is not however essential that a medicine should be odorous, to exert a sympathetic influence on the habit through the organ of smelling: many inodorous powders, snuffed up the nostrils, produce a powerful effect, which is not confined to the stimulated surface.

Such are the principal media by which medicines affect the living system through the nerves. In possessing a knowledge of these facts, we are led to consider—1. the nature of the impression which any medicinal agent makes on the surface receiving it: 2. the relative connection between that part and the principal organs. It must, however, be supposed that the sympathetic effect is always in accordance with the force of the local impression: a large dose of Hydrocyanic acid, which instantly destroys the nervous energy, displays scarcely any obvious effect on the organic surface

to which it is applied. It may be questioned whether the influence of contiguity depend upon nervous connection? There is much difficulty in replying to the question: but, in whatever manner it may be answered, there is no doubt that the effect of medicines on one organ extends to others in the vicinity.

ACTION OF MEDICINES ABSORBED IN THEIR ENTIRE STATE.

A medicine may be conveyed undecomposed into the circulation, and influence the general system.

There are three ways by which medicines may be conveyed into the circulation: they may be taken up by absorption from the intestinal tube:—by absorption through the skin;—by absorption through the lungs.

1. The proofs that medicines are absorbed from the intestinal canal are numerous; but a few only require to be noticed. If Rhubarb be swallowed, and pure Potassa be added to the urine passed a few hours afterwards, the presence of the Rhubarb in it will be readily detected by the lake-colour, which the addition of the Potassa produces; or if an animal, for example, a fowl, be fed for some time on food mixed with Madder, the colouring matter of this substance will be found deposited in the bones. But other substances besides those which contain colouring matters can also be detected in the urine: for instance, Nitrate of Potassa, the salts of Iron, and Hydrocyanate of Potassa: and this happens even when the substances are not taken into the stomach. Seven minutes after injecting a solution of the Hydrocyanate of Potassa into the bronchial cells, the presence of this salt has been demonstrated in the urine.* Now, in all these cases, the substances must have entered the circulation undecomposed, before the Rhubarb or the Nitrate of Potassa, the Salts of Iron, or the Hydrocyanate, could have appeared in the secretion of the kidneys, or the Madder be deposited in the bones. That such medicines do not pass, however, in

* *Traité Elementaire de Mat. Med.* par J. B. G. Barbier, &c. vol. i. p. 69.

the manner of digested matter through the lacteals, is probable, since they have never been detected in the chyle of the thoracic duct by the most delicate tests. It is probable that they are taken up by the lymphatics, which open upon the internal surface of the intestinal canal; yet this supposition is beset with difficulties, for these substances have never been detected in the blood. It must, however, be admitted that, although Rhubarb and many other substances taken into the stomach, which pass into the urine, cannot be detected in the blood, yet that other substances, the Hydrocyanate of Potassa, for instance, have been detected in that fluid. Dr. Meyer injected it into the lungs through an opening in the trachea; after some time, he found it in the blood, on testing that fluid with Sulphate and Hydrochlorate of iron. Dr. Chapman, an American writer on *Materia Medica*, and some others, suppose that these substances are decomposed in the stomach; that their components enter the circulation under the influence of the vital energies, which prevent them from recombining; but that, as soon as they reach the secretory or excretory organs, they are thrown, as it were, beyond the sphere of these energies; and their chemical affinities being brought into play, they recombine, and the substance is again perceptible, or can be detected by tests in the excretions. But however ingenious this hypothesis may be, it is utterly destitute of probability. What secretion is beyond the sphere of action of the vital energies? What excretion is totally free from the influence of these, until it is discharged from the body? These questions must be answered satisfactorily, before we can admit Dr. Chapman's conclusions.

The surfaces which receive the impression of medicinal agents in the intestinal canal, are all furnished with absorbents opening upon them, by which the medicine is taken up: but it must be in immediate contact with the absorbing mouths opening upon the part. These absorbents are most energetic on the mucous membrane of the intestines, and that of the air tubes of the lungs. Plethora diminishes the facility of getting medicines into the system by these channels; blood-letting and other depleting measures increase it.

2. The absorption of medicines by the *skin* is less easily

demonstrated. The true skin is furnished with innumerable absorbent vessels and nerves; the resemblance between it and the mucous lining of the internal open, tubular, cavities of the body is so great, that many anatomists consider the mucous membrane as a prolongation of the skin, modified to suit the function of the part which it covers. The skin, however, differs in several particulars from the mucous membrane: it is covered with the cuticle, whilst the mucous membrane is defended solely by its secretion; the vascular stratum of the cutis is not separable from the thick substratum which supports it, whilst in the mucous membrane these are easily separated. A question arises, does the skin actually exercise the function of absorption?

The opinions respecting cutaneous absorption are yet very unsettled. The observations and experiments of many celebrated physiologists, among whom are Drs. Klapp, Rousseau, Dangerfield, Chapman, and Dr. John Gordon, whose early death can never be sufficiently lamented by all who feel an interest in the advancement of medical science, tend to disprove the existence of cutaneous absorption whilst the cuticle remains entire: but, on the other hand, experiments, as conclusive in support of the opposite opinion, are detailed by Keil, Haller, Home, Cruickshank, Watson, Ford, Abernethy, Dr. Kellie, and others. Experiments upon the lower animals would, indeed, lead us to adopt that opinion which supposes that the skin absorbs fluids placed in contact with it; but it is from reasoning upon these analogically, that the assertion of the power of the human skin to absorb, when covered with the cuticle, solely rests. In the experiments of Seguin,* although that philosopher concludes that there is no absorption, yet, it was evident that the human body, when immersed in water at 90° of Fahrenheit, lost nothing in weight beyond that which is usually exhaled by pulmonary transpiration. But this may have arisen as well from the cutaneous transpiration being checked, as from absorption; and such is more likely to have been the case, as no increase of weight followed the immersions. In the experiments

* *La Medicine Eclairée*, &c. tom. 3.

of Drs. Currie and Gerard, in which the body was also immersed in hot water, no loss of weight was suffered during the immersion; but Dr. Kellie argues in favour of absorption, from these experiments, remarking that, although the body was doubtless wasted by the pulmonary and cutaneous discharges, yet the weight of it continued unchanged; or where a loss was observed, this was constantly less than is experienced during the same interval in the air.* But the most singular fact in favour of cutaneous absorption, is that related by Dr. Percival of a horse-jockey, whose weight increased thirty ounces, although in the interval he had taken nothing but one glass of wine. That absorption occurs to a certain extent, there can be little doubt; but it is a question—whether this is a function of the whole skin, or of a part?

From some experiments instituted by Dr. Rousseau of Philadelphia, there is reason for thinking that the function of absorption is enjoyed only by certain portions of the skin; that space, for instance, which extends between the middle of the thigh and the hip; and that between the middle of the arm and the shoulder. When fomentations and poultices of Rhubarb or of Madder were applied to these parts, the colouring matter could be detected in the urine; but it could not be discovered when they were applied to any other part of the skin. It is not easy to explain this fact, as no anatomical peculiarity is obvious in the cuticle of these portions of the skin. Dr. Rousseau also demonstrated that Garlic, Spirit of Turpentine, and some other substances which have been supposed to find ready access to the habit through the skin, enter by pulmonary absorption. When he breathed through a tube, which passed from the room in which he was placed, and opened upon the external air, although the body was bathed with the juice of Garlic, or immersed in an atmosphere of Spirit of Turpentine, yet, these fluids were not detected either in the breath or in the urine.

The cuticle is the chief obstacle to cutaneous absorp-

* Edin. Med. and Surg. Journ. vol. i. p. 182.

tion; and, therefore, when friction is employed to abrade this covering, or when it is removed by the operation of any substance which causes vesication, the skin absorbs freely; and thus medicines have been introduced into the system by cutaneous absorption. This is, nevertheless, a very uncertain method of introducing medicines; and there is much truth in the remark of M. Barbier, that it does not fulfil all which it seems to promise.* But experience has also demonstrated that some medicines find a passage into the system, even when the cuticle is apparently not abraded: for example, the habit may be affected by wearing mercurial plasters; by immersing the body in a bath of very dilute solution of Corrosive Sublimate, at a temperature of 70° of Fahrenheit; or by exposing it to mercurial fumigation.

3. The third way by which a medicine may enter the system undecomposed, and exert its influence through the medium of the circulation, is absorption through the lungs.

Some experiments of Dr. Rousseau are sufficient to prove that Turpentine, Musk, Garlic, Camphor, and some other volatile substances are very rapidly absorbed by the lungs, and taken into the course of the circulation. There is no reason for supposing that any decomposition of the medicines occurs in these instances. Whether gases are absorbed is uncertain; indeed, it is difficult to conceive how they could be condensed, and carried undecomposed through the course of the circulation. Although the air is the vehicle by which volatile substances are conveyed into the lungs, and although it undergoes a chemical change in the bronchial cells, yet, this does not affect the volatile matters held in solution by it when it is inspired: these are taken up by the absorbents opening on the mucous membrane of the bronchial tubes; whence they are carried into the circulation, and again excreted by the kidneys and the skin. In their passage, however, they powerfully stimulate the nervous system, and occasionally produce as decided an influence on the body as if they had been taken into the stomach. An excellent illustration of this fact is observed in those persons who are

* *Traité Element. de Matière Medicale*, vol. i. p. 60.

employed to pump ardent spirits from large casks into small vessels for the convenience of the retail dealer. If this operation be performed in a cellar, or in any confined place, the assistants become intoxicated without taking the spirits into the stomach. It might be supposed that, as the whole body, in these cases, is immersed in an atmosphere highly impregnated with the volatile matters, the skin and the lungs may be regarded as the inlets; but there is no direct proof that, even when the cuticle is removed, ardent spirits can be taken up by the absorbents of the skin, nor even by the lungs; whereas the proof is direct, that they affect the system and produce intoxication by acting on the olfactory nerves.

The difference between the mucous membrane of the bronchial tubes and the skin or cutis, as I have already informed you, consists in the medium interposed between them and the air: in the skin this medium is the cuticle; in the lungs it is a fine epithelium, which certainly is more likely to permit imbibition than the cuticle. It is possible, that in this manner, and not, strictly speaking, by some true vascular or lymphatic absorption, some volatile matters admitted into the lungs are conveyed into the circulation.

ACTION OF MEDICINES DECOMPOSED IN THE STOMACH, OR AFTER ENTERING THE SYSTEM.

The decomposition of medicinal substances may take place in the stomach, or in the blood, or in some secreting organ.

1. A medicine may be decomposed in the stomach, and act on the nervous system by one or more of its constituents.

With respect to vegetable medicines, this decomposition is effected in the same manner as that of alimentary substances. Many experiments have ascertained the fact, that all simple aliments, such as *albumen*, *gelatin*, *fibrine*, *caseous matter*, *vegetable mucus*, *sugar*, *starch*, and *gluten*, are soluble in the gastric juice; and that all compound aliments, containing these substances as constituents, are also dissolved by it, under certain conditions connected with the structure of the compound substances. A substance, for instance, the

components of which are, when separate, readily soluble in hot water, is very quickly dissolved in the gastric juice. It is less quickly dissolved if the components, separately, require the assistance of acids for their solution ; as those, for instance, which contain much *gluten*, *concrete albumen*, *fibrine*, and *caseous matter* : and the gastric juice scarcely acts at all upon the *husks of grains*, the very *hard fibres of woody plants*, *hairs*, *feathers*, and substances of a very compact texture. Now, as all vegetable substances are components of some of these simple aliments, and are more or less susceptible of solution in the stomach, it is evident that all vegetable medicines must also undergo digestion to a certain extent : although it is probable that some of them previously act upon the nerves of the stomach. The decomposition, however, is generally first effected, and the active principle being thus extricated, acts either *directly* upon the nerves of the stomach, or escapes into the circulation, whilst the other constituents are completely digested. It is to this circumstance that we may ascribe the time which elapses after swallowing some medicines, and the period when their operation becomes apparent. Thus, if half a drachm of powder of the root of *Ipecacuanha* be swallowed, from fifteen to thirty minutes generally elapse before vomiting is produced, a circumstance which we may fairly attribute to the envelopment of the *Emetina*, the active constituent of the *Ipecacuanha*, in the *Wax*, *Gum*, *Starch*, and *ligneous matter* of the root : it cannot exert its influence until extricated from these by the process of digestion. In this manner, also, *Veratria*, the active ingredient of *Colchicum* ; *Strychnia*, that of *Nux-vomica* ; and the medicinal principles of many other substances ; are separated and pass into the circulation. The decomposition of medicines in the stomach by the digestive function, is not, however, confined to vegetable matters ; the *Acetas Potassæ*, and some other salts in which vegetable acids enter as components, are liable to undergo the same process ; the acid is digested, whilst the alkali passes into the circulation, and is excreted by the kidneys. Such is the result of the digestive process on many medicines ; those parts which are readily soluble in gastric juice

are digested ; whilst the active principle is set free, remains unaltered, and exerts its influence on the system. In all these, and similar instances, the decomposition is effected by the vital powers of the stomach ; and the active principle of the medicine which is eliminated either acts *directly* upon the stomach, extending its influence to distant parts of the system, or it is absorbed and carried, in the course of the circulation, to those organs on which its appropriate action becomes apparent, whether *diuretic*, *sudorific*, *expectorant*, or otherwise.

Medicines taken into the stomach are also decomposed by chemical means. The acids existing in the stomach are chiefly the Acetic* and the Hydrochloric or Muriatic ; and the quantity of these is more or less augmented by the state of the stomach, and the stimulant quality of the food. Pepper or any spice, for example, greatly increases the secretion of these acids. Many morbid causes, particularly those which augment the irritability of the stomach, increase also the secretion of these acids ; and, from their superabundance, they become prominent symptoms of that diseased state of the digestive organs which constitutes *Dyspepsia*. If, during this condition of the stomach, any alkaline Carbonate be swallowed, a chemical action immediately takes place in the stomach between this Carbonate and the acids of the gastric juice ; the Hydrochloric acid, having a greater affinity for the alkaline base of the Carbonate than the Carbonic acid has, unites with that base, and, setting free the Carbonic acid in a gaseous state, forms a new salt, with the base of the Carbonate. In this instance, the chemical decomposition of the medicinal substance is effected exactly in the same manner as in the laboratory of the chemist, at a temperature equal to that of the living stomach ; one of the components is immediately rendered active ; whilst the new compounds, produced by the union of the alkaline base with the acid of the stomach, the Hydrochloric, or with the Acetic if present, vary in their operation according to the chemical nature of the Carbonate

* Dr. Prout believes that the Acetic acid, when present, is always derived from the aliment.—*Phil. Trans.* 1824.

employed. Thus, whatever may be the base of the Carbonate, the first effect of the decomposition is the extrication of Carbonic acid, which, being dilated by the natural heat of the body, and closely applied to the nerves of the stomach, augment their energy and increase the tone of the organ. The second effect is varied by the nature of the new salts which are formed. If the alkaline base be *Soda*, the new salts generally pass out of the stomach undecomposed, and operate as purgatives; if *Potassa*, the Acetate, produced by the chemical process, is again almost immediately decomposed by the digestive function: the acid mingles with the chyme; whilst the Potassa, eliminated, is taken into the circulation, and, being carried to the kidneys, stimulates these organs to increased action, and promotes the excretion of the urine. Whatever is the base of the saline body employed, the Carbonic acid always plays the same part, producing a direct tonic impression upon the stomach at the moment of its extrication. With regard to the varied actions of the new products, it is unnecessary, at this time, to notice these more particularly: what has been said is sufficient to illustrate the fact, that a medicine may be decomposed in the stomach, and operate by one or more of its components.

2. A medicine may be absorbed entire, and be afterwards decomposed, either in the course of its circulation in the blood-vessels, or in some particular secreting organ, and operate on the nervous system by one or more of its components.

This proposition is by no means so easily demonstrated as the former, although there are results following the administration of some medicines which can only be explained on the supposition of a decomposition, such as it describes. If Mercury, for example, in the state of an oxide, that is in chemical union with oxygen, be taken into the stomach, or be introduced by any other means into the system, the medicine is first absorbed, undecomposed, into the circulation; and, after a time, according to the state of the habit of the body of the person employing it, exerts its influence chiefly upon the secreting organs, and more particularly upon the salivary glands. I am not aware of any

experiments which have detected the mercurial employed in the saliva ; but, when gold is carried in the pockets of a person whose habit is charged with Mercury, that metal becomes whitened in the same manner as if an amalgam were formed by rubbing metallic mercury upon its surface. Now, although this prove that the Mercury escapes from the body through the exhalant pores of the skin, yet, it does not inform us of the state in which it is thrown out ; whether it still continue as an oxide or a salt, such as it was when taken into the body ; or whether it have suffered reduction, and is expelled in the state of mercurial vapour, a state which experiments with the air-pump and other circumstances have informed us the metal can assume. But, if direct experiments are insufficient to satisfy our enquiries on this point, the fact that metallic Mercury has been detected in the bodies of those who have died*, after being fully under its influence, affords some ground for supposing that the mercurial preparations employed as medicines, unless they quickly pass off by the bowels, are decomposed either in the course of the circulation or in the secretory organs ; and, if this be actually the case, it is probable that they operate by one or more of their components.

In offering this explanation of the mode in which mercurial preparations operate, as an illustration of the decomposition of medicines in the system, it is only candid to admit that it is scarcely sufficiently demonstrative to be completely satisfactory. The reasoning, however, is supported by phenomena which attend the employment of the preparations of some other metals. The Nitrate of Silver is a salt, composed of Oxide of Silver and Nitric Acid ; and the only salt of silver which is employed as a medicine. When applied to the moistened surface of the skin, it acts as an escharotic ; that is, it destroys the life of the part to which it is applied, and forms a chemical union with the animal matter ; or, in

* The authors who have borne the most accurate testimony to this fact are Fallopius, de Morbo Gallico, c. 76 ; Johannes Fernelius, de Luis Vener. Cur. c. 7 ; Mayerne, Praxis, l. i, c. 8 ; Wepfer, de Apoplexia, p. 303 ; Fontanus, Resp. et Cur. Med ; Lentilius, Miscell. Med. pr. vi—i, p. 74 ; and Mr. Brodfelt, Mem. of Med. Soc. of London, vol. v.

other words, perhaps more explicit, the affinity of one or more of the components of the Nitrate of Silver, for one or more of the components of the substance of the body, is greater than the power of the vital principle is capable of withstanding, and therefore they enter into chemical union; a new compound is formed; and the oxide of the decomposed Nitrate, entangled, as it were, in the disorganized skin, becomes black. If this salt be largely diluted, and given internally in small doses, or even if it be administered in the solid form, in pills, it produces a powerful tonic effect upon the system; and, in some instances, it leaves a permanent tinge of a leaden hue upon the skin. Now, it is evident that this effect could not take place if the Nitrate of Silver were not taken into the circulation in an undecomposed state; for, if the Nitrate were decomposed in the stomach, and converted into Muriate of silver, this is an insoluble salt, and, consequently, not fitted to be taken up by the absorbents. But if we admit that the Nitrate of Silver is taken into the circulation in its undecomposed state, we can readily explain the manner of its decomposition by the capillary vessels of the skin, and its deposition in the rete mucosum, in the state of an insoluble Muriate, which would necessarily render any tinge communicated by it to the skin, permanent. That the colour is the result of Muriate of silver deposited in the rete mucosum, and acted upon by light, is rendered highly probable by observing the action of light upon paper soaked in a solution of Muriate of Silver. The light changes this Muriate, or, more correctly speaking, Chloride, from white to dark violet—a fact easily demonstrated. The Muriate deposited in the rete mucosum is changed in colour in the same manner; and, being insoluble, the colour is fixed, remains during life, and causes that leaden hue of the complexion which has unfortunately, in several instances, followed the administration of Nitrate of Silver. This is not the place to explain the manner in which this change into the Muriate takes place in the skin; but the fact is another proof of the assertion, that there are medicines, which, after being taken into the circulation, in an entire state, are decomposed in their progress through it.

REVULSIVE OR COUNTERIRRITANT ACTION OF MEDICINES.

The influence of new diseased actions, for instance those produced by cutaneous eruptions, in relieving even inveterate functional diseases, is familiar to every one who has observed the effects of either the therapeutical efforts of the constitution, or of the means employed by the physician. Medicines which operate in this manner change the seat of irritation; set up, as it were, a new centre of morbid perceptions; and, according to the law of the system, that, by increasing the sensibility of one part, we diminish that of the neighbouring parts, the blood is directed in greater quantity to the part thus acted upon; or, in the language of the ancients, a revulsion is produced.

The beneficial effects of many medicinal agents can be readily explained upon this principle; as, for instance, those of rubefacients, vesicants, and escharotics: thus, an incipient inflammation of the tonsils is often rapidly removed by the application of a liniment, composed of Ammonia and a fixed Oil, to the fore part of the neck: an attack of gout in the stomach, by the application of boiling water to the pit of the stomach: and deep-seated pains, by the operation of caloric in the form of the actual cautery. But the benefit of counterirritant action is not confined to external applications. The advantages derived from the use of purgatives, in affections of the head and chest, are justly referred to their counterirritant influence: even sudorifics and diuretics act as revulsives, and the benefit derived from their employment is the result of the same counteraction, set up on the skin, and in the kidneys.

This mode of action is employed for one of two purposes: either to change the irritation or excitement from the viscera to the skin; or to transfer it from the viscera of one cavity to those of another. But much caution is requisite in the employment of this description of medicinal action: it may augment the general excitement to a degree sufficient to aggravate rather than to diminish the disease for which it is employed. Thus, as I shall particularly prove, in treating of vesicants, the

application of blisters so considerably quickens, and so much increases the force of the general circulation, that they are unfit remedies in the early stage of extensive acute inflammation. It is, however, necessary to distinguish between this state of excitement and that general irritability of the system, which is often accompanied with fugacious pains, and a small, quick pulse; in which the application of a blister, or other local remedy, acting upon the principle now under consideration, seems to bring the irritation, as it were, into a focus, and thus relieve the system.

CHEMICAL ACTION OF MEDICINES.

Medicines operate in this manner by combining chemically either with the substance of the body itself, or with the contents of the stomach and the first passages.

1. Some medicines when applied to the surface of the body enter into chemical union with the animal matter of the skin, destroying the vitality of the part to which they are applied, and forming with it a new chemical compound. This fact is undeniably established as far as refers to the local action of some substances: for example, the pure Alkalies, the affinity of which for the components of the animal solid is so great, as completely to overcome the resisting powers of the vital principle, and to produce with it a saponaceous compound.

When the same medicinal agents are introduced, in a less concentrated form, into the stomach, changes in the nature of the contents of that organ take place; and changes, frequently also, follow in the secretions and other fluids of the body: thence the question suggests itself—"Is this owing solely to the chemical influence of the substances employed?"—The answer may be safely given in the negative: there is no reason whatever for supposing that these changes depend upon any direct chemical influence of the medicines upon the fluids themselves: but, on the contrary, they are the result of new actions induced in the secreting organs which produce them. Thus, if any organ be too highly excited, the stomach or the liver, for example, the natural and

healthy characters of the secretions of the organ may be so changed as to render them inadequate to perform the part allotted to them in the healthy economy of the body ; yet, in these instances, it cannot surely be asserted, that the stimulants, whether medicines or alimentary substances, which brought about these changes, operated as chemical agents. Indeed, if it be admitted that the blood is endowed with vitality, of which there can be no doubt, it is impossible to admit the influence of chemical agency in affecting any direct changes upon that fluid, in reference either to the nature or the relative proportion of its constituents, short of the destruction of its vitality, and consequently that of the body itself ; and if this be true of the blood, it must be equally so of all the secretions which are separated from it. Some medicinal substances, or their components, indeed, have been detected in several of the secretions ; but in these instances, the substances are merely mingled, not chemically combined with the secreted fluid. There can be no hesitation in asserting, that no chemical change is ever effected upon the blood, or on the secretions, by medicines acting chemically ; that is, changing the affinities and altering the chemical characters of these fluids. Is it the vitality of the system, extended to the fluids, which prevents chemical changes being produced in them by the affinities of chemical agents taken into the stomach ? This question may be answered affirmatively ; for, were it otherwise, there would be hourly, and even momentarily, such changes taking place as would completely interfere with the harmony, and soon destroy the integrity, of the system.

SECTION II.

GENERAL EFFECTS OF MEDICINES ON THE VITAL SOLIDS AND FLUIDS ; AND ON THE FUNCTIONS.

Having acquired some knowledge of the manner in which medicinal agents act on the living body, our next object is

to ascertain what are the effects resulting from their action. These are conspicuous either on the living solid, or on the fluids, or on the functions of the principal organs

EFFECTS ON THE LIVING SOLID.

It is not easy to define what the living solid implies, nor is it essential for our purpose. It is sufficient to know that the term is employed to express an indefinite idea of what we suppose to be the ultimate fibril of the organic tissues, whether cellular, muscular, or nervous: and it is probable that the change in the condition of any organ, produced by a medicinal agent, is owing to some change in condition or arrangement which the medicine impresses on this fibril. Thus the action of the heart is augmented after a dose of alcohol has been taken into the stomach: we can form no other idea of the cause of this, unless we suppose that either the nervous fibrils in the stomach, from the contact of the alcohol, undergo some change in their condition, which is followed by a corresponding change in the contractile fibres of the heart; or, that the alcohol carried into the circulation is applied to the tissue of the heart, and effects the same change by the immediate application of its particles to the ultimate fibrils of which that tissue is composed. But neither the existence of the fibrils, nor the nature of the change which they suffer, is capable of demonstration: we found our belief of both solely upon the effects which we observe invariably to follow the internal administration of a dose of alcohol. These are a sensation of warmth in the gastric and thoracic regions, a more forcible action of the heart, and an increased momentum of the blood, inferred from the state of the pulse, compared with that which existed before the alcohol was taken. All medicines producing effects similar to those referred to the alcohol we regard as *stimulants*; whilst, those the administration of which is followed by diminished action, a preternatural decrease of the general momentum of the blood, and a lowering of the animal temperature, are regarded as *sedatives*. The general primary effect of every medicinal agent upon the living solid may be, therefore, said to be either stimulant or sedative.

This, however, is not the prevailing view of the subject:—the primary influence of every medicine on the living solid is regarded as stimulant; whilst the sedative effect is supposed to be altogether negative, the result of the prior stimulant impression; or, in other words, that any sedative effect which follows the administration of a medicine is that state of collapse which always succeeds the stimulant action of substances that operate directly on the nervous system. This reasoning is undoubtedly in perfect accordance with the law of the system, that all impressions made upon nerves have a direct tendency to exhaust their energy, and an indirect tendency to lower the power of the system in general: but, nevertheless, the same train of reasoning which admits of the conclusion, that the effects which follow the administration of certain medicines are the result of a stimulant impression on the living solid, authorizes, on the other hand, the assertion, that the diminished momentum, and other phenomena indicative of an abstraction of power, which immediately succeeds the administration of other medicines, are as truly the result of a positive change of constitution in the living solid which may be termed *sedative*. Other arguments might be advanced in support of this opinion; but, as it must again be discussed in treating specially of sedatives, the further consideration of it is unnecessary at present.

The influence of medicinal agents on the living solid is greatly increased during general disease; and even in the diseased states of different organs. Upon these the effect of a stimulant, which is scarcely perceived in a healthy state of the organs, becomes strikingly obvious: as is well illustrated by the effects of stimulants in inflammatory conditions of the pulmonary tissue: a glass of wine, in such a state of the chest, immediately renders the cough more frequent and stronger, and greatly exasperates all the other symptoms. Disease, in augmenting the sensibility of parts, bestows on substances medicinal properties which they seem to lose as soon as the nervous system recovers its natural condition: on the other hand, it also lessens the sensibility of parts.

In observing the general effects of medicines on the vital solid, during disease, it is important not to confound them with

those salutary processes of the constitution which are frequently exerted to free the system from conditions of its organs altogether inconsistent with the due performance of its general functions.

GENERAL EFFECTS OF MEDICINES ON THE FLUIDS OF THE
LIVING BODY.

The most important of the fluids, and that from which all the others are formed, is the blood. The chyle, which is constantly pouring into the blood-vessels to supply the waste of this vital fluid, is assimilated to the blood in these vessels; not by simple agitation or motion, but by an organization; for, although sanguification has begun before the chyle reaches the subclavian vein, into which it passes from the thoracic duct, yet, it is perfected only in the course of the circulation. If this be admitted, it is easy to conceive that every variation in the state of the circulation may produce some difference in the state of the blood; but this, if it be the effect of medicines, can be attributed only to their influence on the living solid, not to any chemical union or combination of the medicinal agent or its components with the principles of the blood. The blood may be mingled with medicines which have been taken into the stomach, and have passed into the circulation either in whole or in part: but during life we see no reasons for believing that any material alteration, even of the physical properties, of the blood occurs from this cause. Some late experiments of Dr. Stevens, on the effect of saline substances upon the blood, seem to be at variance with this opinion: but these are too little understood to be brought forward as opposing the opinion which has been advanced.

What has been stated of the blood might be regarded as applicable also to the secretions and excretions; but some of these, in particular the urine, display chemical differences of composition, after medicinal substances have been administered: this forces us to pause before asserting, positively, that no chemical changes are effected by medicines in the secreted fluids. It is probable, however, that many of the changes in the nature or the proportion of the components of

the secreted fluids, as before stated (p. 7), are the results of a new action excited in the organs secreting them, rather than of any chemical action of the medicines which produce these changes.

GENERAL EFFECTS OF MEDICINES ON THE FUNCTIONS.

In treating of these, it is scarcely necessary to refer to the connection between the organic tissues, on which medicinal agents directly operate, and the functions of the organs of which these tissues form the physical components. An unusual impression is made on the nervous tissue of an organ; and a modification or change of function is the result. This effect of medicines becomes apparent in changes displayed not only in the state of the cerebro-spinal system, as indicated by the condition of the organs of the senses; the functions of the circulation, respiration, animal temperature, digestion, nutrition, secretion, perspiration; and the aptitude of the muscles for exerting their various movements; but, also, in the state of the mental faculties, perception, attention, memory, the power of abstraction and judgment; and the appetencies, comprehending both desires and aversions. The observation of the changes or modifications in each or all of these faculties, during the action of a medicinal agent on the body, affords the chief means of determining the therapeutical character and value of medicinal agents. It is of great importance, however, not to confound the functional modifications which are the result of medicinal action, with those which occur from natural causes; such, for instance, as will often augment or diminish the force and frequency of the pulse, hasten or delay the digestive process, produce variations in the respiratory function, increase the insensible perspiration to sweating, or vary the natural excretory functions of either the intestinal canal, the kidneys, or the uterus. Thence the necessity of distinguishing those temporary modifications of the functions which may occur, independent of medicinal agency, even during the administration of medicines: for it is well known that many morbid states, for instance, convulsions, palpitations of the heart, or cough, may cease after the administration of a medicine, and, nevertheless,

these salutary effects not result from the influence of the remedy. On the other hand, it is undoubted that medicinal agents exert a decided influence on the vital functions; and, consequently, in altering the condition of diseased organs: a fact, the proof of which rests upon correct and careful observations, that the same effect is always observed, all things being equal, to follow the administration of the same medicine. A single example only, is necessary to illustrate this fact. The liver becomes defective in its secreting function; the bile which is formed is therefore necessarily not that of health; the quantity, even of this imperfect secretion, which passes into the duodenum, is too scanty for the purposes which it is designed to serve in the process of digestion; and the intestinal canal becomes torpid: but, after the administration of repeated doses of Calomel, followed by Colchicum, the healthy function of the liver returns; the bile flows freely into the duodenum; digestion proceeds with renewed vigour; and the intestinal canal again regularly performs its office. In such a case, the influence of the medicines on the functions of these organs is obvious; and the manner in which the salutary effect is produced can be readily explained. Thus, the Calomel, being taken into the circulation, and exciting the whole capillary and glandular system, stimulates the languid *pori bilarii*, which are supposed to secrete the bile from the blood of the extreme branches of the *venæ portarum*, and renews their secreting function: the Colchicum then administered passes into the duodenum, and stimulates the orifices of the common duct; this excitement extends to the liver and the pancreas, and, driving the fluid contents of both the hepatic and pancreatic ducts in that direction, the bile and pancreatic juice flow abundantly, and restore the process of chylicification. It is scarcely necessary to add that, the nutrition of the system being improved, the stomach, in common with all the other organs, acquires fresh vigour; whilst the undecomposed bile, acting as a stimulus to the intestines, restores the peristaltic motion necessary for the due performance of their function.

It only remains to point out the distinction between the physiological and the curative, or therapeutical effects of a

medicine. The first are the most important to be understood by the physician, as they depend upon the immutable and constant influence of the active principle of the substance operating upon the organic tissues ; whereas the second are modified by a variety of circumstances connected with the state of the body, and the nature of the diseases against which the medicine is employed. To illustrate this by a familiar example :—a solution of Acetate of Ammonia is prescribed to produce perspiration, the patient remains in bed, and the intention of the prescriber is fulfilled : but if, instead of remaining in bed, the patient expose the surface of the body to cool air, no perspiration flows ; the action of the kidneys is increased, and the discharge of urine considerably augmented. Under both circumstances, the primary or physiological influence of the medicine is the same ; its operation upon the cutaneous capillaries is favoured by external warmth, and continues as long as the surface is kept warm ; but, when the body is exposed, the action on the superficial capillaries is immediately transferred to those of the kidneys. Again—the physiological effects of a purgative are an increase of the intestinal secretions, and an acceleration of the vermicular and peristaltic movements of the canal ; so that the solid contents of the intestines are more rapidly carried through them, and ejected in conjunction with many fluid matters, which are thrown into them by the extension of the excitement to the liver, the pancreas, and the intestinal exhalants. The therapeutical effects are the improvement of the digestive function, the removal of headache, and of many uneasy feelings which depend on the protracted retention of the fœcal matter in the intestines ; and the derivation of blood from the head or the chest, by the counterirritation exerted on the mucous membrane of the alimentary canal. The Physiological phenomena always more or less follow the administration of the drug ; the impression is made on the organ, although it may not be adequate to produce the usual or expected result :—the Therapeutical, on the contrary, depend on a variety of circumstances, which may or may not aid the removal of the diseased state for which the medicine is prescribed. The therapeutical efficacy of a medicine, however,

may be justly anticipated with more or less certainty by observing the degree of energy which the agent exerts in its primary action on the organic tissues. It must, however, be admitted that no part of medicine has experienced so much the influence of prejudice and the vicissitudes of fashion. Bloodletting has been occasionally banished from practice, and at other times carried to the most absurd and alarming extent: the use of Antimony was forbidden by a public edict in Italy, where it is now administered in doses that startle British practitioners: numberless evils were ascribed to Cinchona bark, soon after it became known in Europe: indeed there is scarcely a medicine, regarding which the most contradictory testimony of its therapeutical value, at different times, may not be collected. These facts demonstrate the necessity of observation, unbiased by theory, and of investigation unfettered by authority, in ascertaining the qualities and powers of medicinal agents.

The following conclusions may be drawn from the foregoing remarks: 1. That medicines exert no specific influence in curing diseases: thence the terms febrifuge, antispasmodic, antiscorbutic, and such like, are merely conventional, to announce a secondary result consequent upon the appropriate action of some medicinal agent upon the vital solid. 2. That medicines may operate on the general habit by an immediate impression on the stomach and alimentary canal, either in their entire form or in a state of decomposition. 3. That medicines entering the circulation may affect the general constitution of the fluids; and produce changes in their qualities, independent of any chemical influence. 4. That medicines passing into the circulation, and being conveyed to distant parts, either entire or decomposed, may there exert certain peculiar energies: and, in doing so, they seem to possess a power of selection which enables the physician to prescribe one medicine for emptying the stomach, another to expel the contents of the intestines, and a third to bathe the skin with a flood of perspiration: and these effects follow with a degree of regularity sufficient to authorize the prescriber to prognosticate their effects.

SECTION III.

CIRCUMSTANCES MODIFYING THE GENERAL ACTION OF
MEDICINES.

Many and very different circumstances tend to modify the operation of medicines. Some of these are connected with the original conformation of the body ; others with the age and the sex of the individual ; some with the situation on the face of the globe in which he is placed, as influencing his system by climate, temperature, diet, and habit ; others, again, with the state of society, its customs, superstitions, and even political relations ; and, lastly, some with the condition of the mind, displayed in temper and intellectual attainments.

ORIGINAL CONFORMATION.

It is justly said that no two men are formed exactly alike. The state of the simple solid varies at birth in the connexion and cohesion of its parts, producing a natural difference in the strength, excitability, and sensibility of the frame ; and in its contractility and aptitude for motion under the power of the will. The relative proportion of the parts also varies ; but, in the greatest number of instances, the disproportion is not so great and so varied as to cause any very striking diversity of action in individuals. The approximation, however, to the same state, depending upon disproportion of parts, in several individuals, is sufficient to constitute classes ; and the correct observation of the influence of this disproportion in producing predisposition to disease, and in modifying the operation of medicines, even in a limited number of instances, may lead us to predicate with confidence its effects, as a general cause of such differences. It is this diversity in original conformation which constitutes what is termed *Constitution*, and which, also, regulates *Temperament* and *Idiosyncrasy*.

Whatever may be the *height* of any individual, there is a standard of relative proportion as far as regards the *head*,

extremities, and *trunk* of the body to one another, which enables us to compare these parts in different persons, and which produces an immediate and general acknowledgment of their disproportion when that occurs. Sculptors and painters have taken advantage of this feeling to fix a measure of height, in proportion to the size of the head, which they regard as characteristic of the perfection of the human figure. I shall not stop to examine the accuracy of this standard ; it is sufficient for our purpose, that certain relative proportions exist, and that deviations from these indicate states of the body which render it more or less prone to disease.

Thus the pulse, *cæteris paribus*, is more frequent in short than in tall persons ; yet, such individuals are not more liable to diseases of excitement ; on the contrary, the *irritability* is greater in tall than in short persons, and even the upright posture, in tall persons, accelerates the pulse from twelve to twenty beats. It has also been remarked, that men who have suffered from diseases depending upon a full or plethoric state of the vessels of the head, and in whom such diseases have frequently returned, have larger heads and shorter necks, in proportion to the size of the body, than other men ; and, therefore, the physician ventures to predict a predisposition to similar diseases, in all those in whom this disproportion is conspicuous. Now, with regard to the modification which this peculiarity exerts on medicines, administered to such persons, it may be readily supposed, that whatsoever increases the flow of blood to the head will prove injurious : thence, those medicines which determine to the head must be avoided.

Dr. Cullen has remarked, from his personal observation, that men of short hands and feet, in proportion to the rest of the body, are liable to a plethoric state of the lungs. It would be extremely difficult, were it necessary, to account for this curious effect of the external conformation of such distant parts upon these important organs : but the knowledge of the fact, and of the influence of many other disproportions—for example, the small capacity of the chest in reference to the rest of the trunk of the body, the flatness of the cranium, and consequent diminished size of the cere-

bral organ, and natural deformities affecting the distribution and circulation of the blood, in modifying the operation of medicines—is valuable to the physician in regulating his choice of remedies for such individuals.

It is a curious fact, that some of these disproportions, even the most striking, can scarcely be regarded as congenital. Thus dwarfs, who have generally large heads in proportion to the rest of the body, are born of the same size and display the same relative proportions as other children; but, after a few years, when they cease to grow, the head has already acquired the dimensions proportionate to a larger body. But, although these disproportions be not congenital, yet the same effect is produced upon the constitution of the individuals who display them; and, consequently, influence the operation of medicines prescribed for their complaints.

With regard to the whole frame, even when there is no disproportion of parts, we find that the natural delicacy and robustness of the body in different individuals of the same age; that an unusual deposition of fat in the cellular tissue, whether less or more than the ordinary proportion; and the general shortness or the tallness of the body, are also circumstances, connected with original conformation, that in a great degree affect the functions of the body: and, necessarily, the action of medicinal agents upon it. Thus, some persons grow rapidly very tall; and, although there may be no disproportion of parts, yet there is generally great irritability of the nervous system, and debility of the muscular frame, so that impressions, which would scarcely be felt by an individual happily possessed of a well-adjusted constitution, become causes of morbid excitement, of pain, and inordinate action in the giant of premature age; and he soon dies exhausted, as it were, by the common stimulants of life. It is scarcely necessary to affirm, that this state of frame must influence and modify the operation of medicines.

Constitution. — But although external conformation, and the proportion of parts to one another, have a considerable influence in determining the *constitution*, and, in a moderate degree, the *temperament*, yet the temperament in particular is much more affected by the irritability of the moving fibre, or

that susceptibility of impression by which its movements are excited. On what does this irritability of the living solid depend? Is it a property solely of the nerves, or inherent in all the primary solids? It was formerly maintained by the celebrated Haller, that irritability is an inherent quality, a *vis insita*, of the muscular fibre, perfectly independent of nervous energy, and entirely different from the sensibility of the nervous fibre*: the opposite opinion was held by Dr. Whytt†; and, although Whytt's opinions were nearly as hypothetical as those of his opponent, yet, it is probable that he was correct in denying the *vis insita*; and this probability is much augmented by the demonstration of the truth of the happy conjecture of the ancients, that there are distinct nerves of sensation and of motion. By this happy discovery, the apparent intricacy and confusion of the nerves have been unravelled; and we can refer with accuracy the changes in sensibility and in the aptitude to motion in muscles to their proper sources.

Whatever may be the cause of nervous energy, men possess it in different degrees—a diversity which produces not only a predisposition to disease, but also tends to modify the operation of medicines. Persons of much nervous sensibility are greatly affected by atmospheric changes: they feel enervated and depressed in humid air, and under a clouded sky; and as much reanimated in serene and cloudless weather. This constitution of body displays itself, also, by the various effects which powerful emotions produce on different individuals. It is recorded of Julius Cæsar that he was subject to Epilepsy on the eve of a battle; yet, the courage of Cæsar was undoubted; and, therefore, these attacks can only have arisen from over mental excitement of a highly susceptible nervous system. On the same principle, we must account for the fact connected with the constitution of the immortal author of the *Novum Organum*, Bacon, who, we are informed, fell into syncope every time the moon was past its full. Many men cannot feel the sentiments of joy and admiration without tears immediately starting into their eyes. Dr. Parry states, that he knew a lady, who had long ceased to nurse, in

* *Elem. Phys.* l. xi. sect. ii.

† Whytt's Works:—On the vital and other involuntary motions.

whose breasts a copious secretion of milk was produced at any time by hearing a child cry*. There are persons in whom great surprise always causes a violent vomiting of bile; and it is well known, that libidinous thoughts generate a copious secretion from the mucous membrane of the genital organs in both sexes. 'This state of the nervous system has even led many men of strong minds to believe in the existence of supernatural beings; and the morbid impressions, thus excited, have sometimes been productive of fatal effects: it is therefore not wonderful that this state of constitution should greatly modify the operation of medicines.

This state of inordinate susceptibility in the nervous system, as it affects the moving fibre, influences, more or less, the circulation of the blood; and, when it is considerable, produces what may be termed a febrile predisposition. The habit of body is thus, as it were, wasted down by the excitement which almost every impression, whether mental or corporeal, produces upon the nervous system; "such men be never at heart's ease." On the contrary, the opposite state, or diminished sensibility of the nervous system, favours the deposition of oily matter in the adipose membrane, and, in the increased bulk and rotundity of the body, afford a conspicuous indication of the greater necessity for more powerful stimuli to rouse the energies of the system. 'These two opposite states are thus correctly described by our immortal dramatist, in the remarks of Cæsar on the character of Cassius, indicated by his appearance:

"Let me have men about me that are fat,
Sleek-headed men, and such as sleep a-nights:
'Yond Cassius has a lean and hungry look,
He thinks too much; such men are dangerous."

No state of the bodily frame modifies so powerfully the operation of medicines as that which renders the nerves exquisitely susceptible of impression. It is not always, however, the consequence of original conformation; but it is often the effect of disease; and, in some instances, is the most striking characteristic of the malady. In Hydrophobia, the nerves which supply the sensibility of the skin are in this condition.

* Elements of Pathology and Therapeutics.

They are so susceptible of impression, that the least motion of the air, even the breath of another person, is felt on the skin, and becomes a source of acute feeling and of great irritation. In a case of inflammation of the theca of the spinal cord, which fell under my care, the sensibility of the skin was so great, that tracing the finger across any part of the trunk of the body produced severe pain: and an issue, which was made in the loins, could not be kept open on account of the excruciating torture, and the muscular spasms which it excited. In those who possess this condition of nerves, not only external agents and powerful mental affections interfere with and modify the operation of medicines, but even volition, here, exerts an extraordinary sway, working either for or against their efficacy, and sometimes completely counteracting their usual effects. The following anecdote illustrates the controul of the mind over the operation of medicines, in such states of the constitution. A lady was labouring under an affection of the bowels, attended with severe pain and the most obstinate costiveness. She was bled; the warm bath and fomentations were frequently resorted to; and purgatives and various anodynes freely administered, but without the least effect upon the bowels, and without either sleep or any diminution of pain being procured. At length, the physician in attendance was informed that she had expressed her conviction that her usual medical attendant, in the country, alone understood her constitution, and was the only person who could relieve her. This gentleman was accordingly sent for; and, although no change, either of measures or of medicine, was resorted to, yet, the bowels were quickly moved, sleep and a cessation of pain followed; and in a few days the patient was convalescent. I have witnessed also frequent illustrations of this influence of mind in modifying the effects of medicines in the treatment of cases of Gonorrhœa, contracted by married men; and, also, by young men who possess a high feeling of moral rectitude. The anxiety of such persons, to be speedily cured, causes a constant direction of the mind to the seat of the disease; a vascular fulness of the mucous membrane, and a state resembling chronic inflammation, are, in consequence, super-

induced, which resist the influence of medicines that would readily cure the disease in those in whom it is a matter of less anxiety and little mental reflection. Such are the differences, depending on original conformation, which produce different states of the body, and constitute that peculiar disposition of the frame in every individual which is termed his constitution.

Temperament.—Upon the same basis the ancients founded the doctrine of Temperaments; intended to classify those states of the constitution which, in certain individuals, from a combination of concurring circumstances, tend to distinguish them from other individuals in whom a different combination exists. The name *Temperament*, applied to these states, originated in an hypothetical idea that organized bodies were formed of different elements, so associated together as to *temper* or exactly balance, one another—an idea as fanciful, it has been justly observed, as that of the standard of beauty. If, said the ancients, all the elements are in just proportion, the *temperament* is perfect; if disproportioned, but yet compatible with health, it is mixed; if disproportioned in a degree incompatible with health, it is *imperfect*. As there is little satisfaction derived from detailing the particulars of a doctrine which depends almost wholly upon conjectural reasoning, I will merely enumerate the external appearances which characterize the two chief *temperaments* established by the ancients, and which are, in some degree, acknowledged by modern physicians.

That temperament which the ancients designated *Sanguine* is distinguished by the hair being of a pale, chesnut colour, passing into one or other of the lighter shades of red, soft and uncurled; the eyes blue, lively, and sparkling; the skin smooth, white, moist, and soft; the habit plump, slightly disposed to obesity, and readily perspiring under exercise; the different members of the body are well proportioned, the movements consequently easy; the pulse undulatory and free; the strength of the body moderate; but, whether this depends on the relative proportion of the fluids exceeding that of the solids, as presumed by Dr. Cullen and others, is uncertain: all the physical functions are performed with facility; the nervous system is highly sensible, the mind

acute and cheerful, very susceptible of pleasure, but irritable and unsteady. This temperament is more frequently perceived in women than in men.

The other temperament, the *Melancholic* of the ancients, is distinguished by the hair being black, hard, and not curling; the eyes dark and deep set; the complexion sallow; the skin coarser than usual, and of a dun hue; and the habit of body hard and meagre; the extremities long in proportion to the trunk of the body; the pulse slow and hard; the gait measured and circumspect; and the strength considerable. In this temperament the mind is slow, cautious, and timid, disposed to gravity, tenacious of all emotions once excited, and, therefore, steady. But, along with this steadiness, there are great obstinacy, a continual feeling of inquietude, a suspicious and jealous imagination, and a desire of revenge which never leaves the mind until it is satisfied. This temperament is seen more frequently in men than in women.

As these states actually exist, there can be only one opinion respecting the influence which they are likely to exert in modifying the operation of medicines. Thus, in the *sanguine* temperament, as the nervous system is highly susceptible of every impression, and the body predisposed to inflammatory action, stimulating medicines must be prescribed with caution; while, on the contrary, in the *melancholic*, the same class of remedies require, frequently, to be freely administered, and at a much earlier period in the disease than is admissible in the opposite temperament.

Idiosyncrasy.—In drawing inferences from *Temperament*, in prescribing medicines, it is of great importance to distinguish clearly between temperament and character: the first depends on natural circumstances; the second, not unfrequently, is the result of education or adventitious circumstances. It is, also, requisite not to confound temperament with those congenital peculiarities which occasionally occur in individuals, and are, therefore, termed *Idiosyncrasy*—a term derived from the Greek words *ιδιος*, which signifies “peculiar,” and *συνκράσις*, which signifies “composition;” the peculiarities which it displays depending on the original conformation or composition of the frame.

Idiosyncrasy cannot, like Temperament, be recognized by exterior signs ; and can be known to the physician only by an intimate acquaintance with the constitutions of those in whom it occurs. It ought to be discovered by the physician ; otherwise the most important and even dangerous results may follow the use of medicines, which, although in general they operate in a manner well known, yet, in peculiar idiosyncracies, produce effects the most opposite to those which might be anticipated.

These peculiarities display themselves in various manners. Sometimes the idiosyncrasy shews itself on the organs of the senses ; at others, on the digestive organs. Thus, some individuals cannot touch certain articles without suffering a rigor and having their teeth set on edge. I know a clergyman who cannot bear the skin to be sponged with vinegar and water, or any diluted acid, without suffering spasm and violent gripings of the bowels. In instances such as these there is probably some peculiar state of the pulpy pencils, the extremities of the cutaneous nerves, which terminate in the papillæ of the Corium : but what that state is, no dissection can demonstrate : and this is not extraordinary, when we reflect that even the actual termination of these nerves in the Corium has, hitherto, eluded observation.

The sense of smelling is also sometimes the seat of Idiosyncrasy. Thus, some individuals cannot bear the smell of cheese without experiencing nausea and an inclination to vomit : others are affected by severe dyspnœa, or difficulty of breathing, by the odour of Ipecacuanha ; and some experience the most distressing effects even from the scent of different flowers. I knew a lady who suffered violent headache the moment she entered a room where the African Geranium, the Pelargonium, was growing, or where any of its cuttings were in water : and another, who could not sustain the most delightful scent of all others, that of the Rose, when concentrated in the essential oil or Otto, without fainting. There are even instances in which the odour of the natural flower cannot be supported without producing violent headache, succeeded by fainting. M. Orfila states that the celebrated Parisian painter, Vincent, suffers in this

manner. In some, the most offensive smells are preferred to the most delightful : Louis XIV was pleased only with the most offensive odours, and preferred that of the urine of the Cat to that of the Rose : Sauvage, the distinguished Nosologist, preferred the smell of putrid and foetid exhalations to that of pleasantly odorous plants.

How far we may regard such examples of Idiosyncrasy as connected with Imagination, cannot easily be determined. Rousseau calls smell the sensitive organ of the imagination : and there is much truth in the remark ; for, by its means, not only do we receive the most delicate and agreeable impressions, but no sensations are recalled to the mind in so lively a manner as those associated with peculiar odours ; and it certainly exercises a powerful influence upon the sensorium commune. It is of importance to know these facts, in order to avoid, in the administration of remedies, the production of effects which may altogether destroy, or at least counteract, the intention for which the medicines are exhibited. The causes of these symptoms are, however, more frequently inherent in the body, than dependent on impressions made on the mind by some external agent.

But Idiosyncrasy displays itself most remarkably when certain substances are taken into the stomach. Few things, for example, are more easily digested and less stimulant than white of egg ; yet, in some persons, whether it be eaten in its raw and fluid or its boiled and coagulated state, it causes sickness. The late celebrated Dr. James Gregory, Professor of the Practice of Medicine at Edinburgh, used to relate of himself, that the smallest portion of the white of egg, taken into his stomach, was almost immediately followed by an eruption on the skin, similar to nettle-rash ; and an instance of the same kind is mentioned by Donatus, of a boy whose jaws swelled, whose face broke out in spots, and whose lips frothed whenever he ate an egg. Boerhaave mentions the case of a person who swelled all over after having eaten a few cherries or gooseberries ; and, in Dr. Pulteney's Life of Linnæus, we are informed that strawberries act as a poison on some persons, causing syncope, succeeded by a petechial efflorescence of the skin. Tissot mentions the case of a friend of his who could

not eat sugar without vomiting. There are some people who can digest beef and the stronger meats easily, but who cannot eat the tenderest chicken without suffering from indigestion. To some persons coffee acts as an emetic. Numerous instances of a similar kind might be mentioned; but these are sufficient to shew the influence of idiosyncrasy in modifying the effects of the ordinary articles of diet upon the frame; and if such be the case with regard to food, there is, certainly, less reason for wondering that medicines should be equally under its controul. Haller details a case in which Syrup of Roses produced convulsions; and Gaubius affirms that he has seen Crab's eyes, a mild testaceous powder, which is now seldom prescribed, produce all the effects of an overdose of Arsenic. Dr. James assured Sir George Baker, that he knew six instances of Antimony producing salivation, although the teeth were not loosened, nor was the breath affected with any fœtor. Dr. Parry mentions an instance of a young lady who never took an emetic without a long-continued coryza immediately following that operation. Dr. Heberden states that he had seen several individuals in whom the internal use of Valerian root caused nettle rash; and Sir Henry Hallford, in a paper which he read in the College of Physicians on *Tic Douloureux*, mentioned the case of a boy of eleven years of age, in whom a dose of Rhubarb was followed, three different times, by an Epileptic fit; and, also, instances of three persons in the same family, on whom the same medicine always produced strangury. Schenklius relates a case in which the general law of astringents and cathartics was always reversed. I know a lady, the wife of a physician, whose general health is good, and whose frame of body is not delicate, yet she cannot take the smallest dose of Calomel without falling into the most alarming syncope: in whatever form the medicine is given, or however cautiously disguised, still the effect is the same, and equally severe in proportion to the extent of the dose.

Other of the vital functions, as well as those of digestion and assimilation, display similar singularities. In some persons the pulse is more regular in disease than in health. I knew an instance in which the pulse was always less fre-

quent in fever than in health : the patient was a man seven feet in height, proportionately robust, and of great muscular power. In a state of health, his pulse never exceeded forty-five beats in the minute ; and, when he was feverish, it fell to forty. The pulse of Napoleon Bonaparte never exceeded forty-four, in a state of health. Dr. Heberden, in the second volume of the *Transactions of the College of Physicians*, mentions a woman of fifty years of age, who had always an intermitting pulse ; yet, after her death, an able anatomist could discover nothing unusual either in the structure or the condition of the heart, or of any part of the vascular system.

Having heard these instances of Idiosyncrasy, this question presents itself : Upon what do they depend ? That they are inherent in the constitution is evident ; but it is uncertain whether the action of the substances producing the phenomena be immediate upon the nervous system, which, in these persons, is in a different condition from that in which it is usually found ; or whether the substance be received into the blood, and operate secondarily upon the nerves. There can be one opinion only respecting those cases in which the Idiosyncrasy is displayed in the organs of touch and of smelling ; and, it is probable, that it is the nerves also which are in fault, when the substance is taken into the stomach. This opinion is founded chiefly upon the fact, that the morbid effects have often been immediately removed by clearing the stomach with an emetic ; which would not be the case were the offending matter absorbed and carried in the circulation before they are produced. Another question arises : is it the nerves of sensation only which are affected ; or, do the nerves of motion, also, share the morbid impression ? It is impossible to seek for a reply to this query in any examination of the state of the nerves in the affected part ; but a probable hypothesis may be hazarded. If it be admitted, that the nerves of sensation must be, in every instance, primarily excited before the motor nerves can act (that is, that the impression made upon any part must be communicated to the brain before the moving organs of the part can be called into action), then, whenever there is any unusual condition of the nerves supplying the vital organ, which is directly acted on by the

substance producing the effect which constitutes the evidence of the Idiosyncrasy—for instance, the stomach in the case where Rhubarb caused convulsions—it may be also admitted as probable, that the impression made upon the sensitive nerves of that organ, being either too acute, or different in kind from that experienced in the usual condition of the nerves, may become too sensible to the brain. Under these circumstances, therefore, a change may be superinduced upon the organs of volition, very closely resembling that which follows volition, only irregular; and those movements follow which constitute convulsions or epilepsy. On the other hand, in that state of nerves connected with some of the Idiosyncracies which have been described, the substances may exert an atonic influence on the sensitive nerves; and, this being extended to the general system, swooning may occur. But, as I have already said, this attempted explanation is purely hypothetical.

Whatever may be the true explanation of Idiosyncrasy, its power of modifying the operation of Medicines is undoubted, and is confirmed by every day's experience: it is, therefore, of the utmost importance, that the Physician, in prescribing a medicine for the first time to any patient, with whose habit he is not well acquainted, should endeavour to ascertain what effect it may have produced when previously administered.

EFFECTS OF AGE IN MODIFYING THE ACTION OF MEDICINES.

The effects of age upon the form and functions of the animal body are sufficiently striking. In some of the lower animals, in particular, the changes that take place cannot be overlooked by the most cursory observer. Thus, the Peahen and the hen Pheasant acquire the plumage of the males as they become old. The various states of the human body, also, at different periods of life, have a very considerable power in modifying the operation of Medicines. In infancy, the general susceptibility of impression, and the mobility of the

frame, are greater, than in adult age, as demonstrated by the production of convulsions from the irritation of teething, and the irritation of the bowels by crude or indigestible food. The blood circulates, also, more rapidly in childhood than in the after periods of life, as indicated by the pulse, which is generally forty or fifty beats quicker in the first year of any person's age than at the period of puberty. In the newly born infant, the pulse is usually one hundred and forty in a minute: before the first year is completed, the pulsations at the wrist are seldom less than one hundred and twenty, in the same space of time: after the first and before the termination of the second year, they are reduced to one hundred: between the second and the fourth, to ninety-six: and at puberty to seventy.

As the period of puberty advances, the habit of body, in both sexes, undergoes a remarkable change. In the male, the beard appears, the voice becomes more grave, the mind less vacillating, and the whole corporeal functions are performed with greater vigour and constancy. In the female, the menstrual discharge shews itself, the bosom enlarges, consenting with the change in the functions of the uterine organs: the mental character is not less altered than in the male: and, in both sexes, the sexual appetite is awakened, as soon as Nature has completed that state of the reproductive organs which fits them for their functions: and all the powers of both the body and the mind ripen into full perfection.

If we trace life forwards, in its progress, we find the vigour of the corporeal frame gradually declining after a certain age: the animal heat lessens with the diminished energy of the nervous system: the power of the heart is weakened; the pulse seldom, even in the healthy state, exceeding sixty beats in the minute: many small vessels become impervious, owing to the blood not reaching the capillaries, and consequently the surface appears dry and wrinkled: menstruation has already long ceased in the female, and the sexual appetite gradually declines in the male.

In these different periods of life, the same medicines produce very distinct effects. In childhood, when the absorbents act feebly, much larger doses of Calomel can be borne with impunity than in adult age: but, owing to the greater suscep-

tibility of the nervous system, full doses of Opium, and some other Narcotics, cannot be administered without the greatest caution. In infancy, also, the ascendent state of the stomach modifies greatly the action of some medicines, rendering those acrid and severe in their operation, which are mild in other conditions of the digestive organ. Thus Antimonials and Wine of Colchicum, being apt to prove both violently emetic and purgative when an acid is present, cannot be safely administered at this period of life.

But as it is not, strictly speaking, the age of the patient, so much as the alterations in the state of the system, which occur at the different periods to which I have referred, and which influence the operation of Medicines, these must be attended to at whatever time they happen. Marks of puberty have, sometimes, displayed themselves at a very early period. Many remarkable instances of this are recorded. Pliny* mentions a boy of Salamis who had attained puberty at four years of age. Craterus is stated to have seen a person whose span of life did not exceed seven years; nevertheless, in that period, he had attained adult age, had been a father, and before death displayed all the marks of old age†. At Willingham, near Cambridge, a boy of the name of Hall died in 1747, in whom all the signs of virility were apparent when he was a year old; and, before he was six, he died with every symptom of advanced age‡. The last-recorded instance is one of a boy named John Sparrow§, who was born at Long Melford in Suffolk. He displayed every mark of puberty at the age of fifteen months; had the countenance of a child of six or eight years old; hair on the upper lip; a gruff voice; and, when his clothes were stripped off, the trunk presented the appearance of that of an adult, the organs of generation being in every respect fully developed; his mental faculties were those of a child. In the female, on the other hand, similar instances of premature puberty have occurred||. Menstruation has been known to continue to the seventieth year.

* Hist. Nat. l. vii, c. xvii. † Phlegon. de Mirab. c. xxxii.

‡ See Phil. Trans. 1744—5.

§ Medico-chirurgical Transactions, vol. xii, p. 76.

|| Medico-chirurg. Trans. vol. xi. Gall sur les Fonctions du Cerveau, p. 260.

In all these instances, either of premature puberty and of adult age, in both sexes, or of a protraction of the menstrual discharge long beyond its usual period in females, the same rules regulate the operation of medicines as if those conditions of the habit occurred at the usual periods: the variations, therefore, must be kept in view, both in prescribing and in reasoning upon the effects of remedies.

EFFECTS OF SEX IN MODIFYING THE ACTION OF MEDICINES.

The differences in external conformation and in the strength of the bodily frame, which distinguish the sexes, are sufficiently obvious to the most casual observer; but there are, also, functional distinctions less evident. Both are likely to influence the operation of medicines.

In children, the general figure of the body is scarcely distinctive of the sexes; but the distinction becomes more and more obvious as the age of puberty advances; when the muscular, robust figure of the youth is strikingly contrasted with the delicacy, softness, and comparatively diminutive stature of the maiden. In the osseous system, the cylindrical bones of the female are more slender, and the flat bones thinner, than in the male, and all are smoother. In the muscular system, the fibres are paler, less dense, and, consequently, weaker: and, with the exception of the glutei, the psoæ, and a few others, the muscles are proportionally smaller. The skin of the woman is more delicate than that of the man, and whiter, owing to the large quantity of fat deposited beneath it, filling up the interstices between the muscles, and producing that beautiful roundness which is characteristic of the sex. Except on the head, on which the hair is commonly in greater quantity and longer in the woman, the parts of the skin covered with hair in men are either entirely devoid of this appendage, or less hairy or covered with a delicate down in women. The capacity of the abdomen and that of the pelvis is greater; but that of the thorax is less in the woman than in the man.

Such are the chief distinctions in the conformation of the frame in the two sexes. Among the functional differences, we may observe, that the female body is more excitable than the male. The circulation is carried on more rapidly; and the pulse is, *cæteris paribus*, more frequent in women than in men: the growth of the body is, therefore, in general quicker; puberty and adult age occur earlier; and, when the former arrives, the proportional quantity of blood passing to the abdomen is greater. Many of the other animal functions, also, differ. The appetite for food, for example, and the power of the stomach to digest it, is less in women than in men. The nervous system of females is more mobile and susceptible of impression; and, consequently, they display more sensibility both of body and of mind than men.

But the chief distinction between the sexes is undoubtedly displayed in the functions of the genital organs. In the male, at the age of puberty, the new action taken on by the testes is accompanied by a corresponding change in the whole system: the susceptibility of the nerves is greatly augmented; and this is powerfully excited by the sexual appetite, which is now first awakened. Much of the future condition of the system depends on moderating the influence of this passion: its abuse is soon followed by permanent languor, sometimes by nervous apoplexy. A much more serious consequence, however, results from the excitement of the generative organs without sexual communication: along with a greater degree of languor and debility than follows the act of coition, the whole nervous system becomes morbidly susceptible of the slightest impressions: indeed the most frequent result of the indulgence of this propensity is a violent paroxysm of mania.

In the female constitution, the commencement of the functions dependent upon the uterine system produces changes of a magnitude and importance much greater than those which have been described as occurring in the male. The menstrual discharge, which commences about the fifteenth year of the age of the maiden in this climate, is usually preceded by sensations of plethora and fulness in the head, heaviness in the chest, tension in the loins, and lassitude of the limbs.

After it has taken place, and is fairly established, the energies both of the body and the mind seem to have received a fresh impulse: the eyes brighten and swell with moisture; the cheek is spread with a fresher bloom; the voice is more harmonious; the hips and breasts expand and enlarge; the movements and attitudes of the young female become more graceful; her mind ceases to engage in childish pursuits; and, as in the youth, those desires are awakened which have been implanted in our nature for the continuance and increase of the species.

The effects of impregnation on the other functions of the female system are still more striking. The blood is sent in greater proportion than usual to the mammæ and the uterus; and the vessels of the latter, from being small and narrow, become so capacious that the veins have been mistaken for sinuses. At this time, also, the vascular system of the female takes on an inflammatory or febrile action; the blood, when drawn from the veins, always displays that appearance, characteristic of inflammation, which is called the buffy coat; the stomach becomes highly irritable; the countenance appears altered; the eyes seem larger, the mouth wider; and every feature is sharpened. Giddiness, dimness of vision, palpitations of the heart, vomitings, great inquietude, and, occasionally, convulsions, are the symptoms indicating the increased nervous susceptibility of the whole frame. Even the temper is so often changed, that the gentlest, the most amiable of the sex become impatient and irascible, to a degree sometimes almost bordering on Insanity—a disease which is readily roused, in those hereditarily disposed to it, in this condition of the female system. After parturition has taken place, and the womb, having relieved itself of its burden, has returned to its ordinary condition, the secretion and excretion of milk maintain a state of the habit considerably different from that which is natural to the female who is not performing the duties of a mother.

It is necessary to examine in what manner those conditions of the habit, depending on sex, exert a powerful influence in modifying the operation of medicines. In a youth just arrived at the age of puberty, when the nerves vibrate to every impression, and the blood circulates with an almost febrile ra-

pidity; when the muscles are strung, as it were, to their utmost tensity, and the mind is elevated to the highest pitch of enjoyment; if any thing occur to hurl the faculties from that state of exaltation and bring on disease, medicines, which in another condition of the body would affect strongly the system, will now produce scarcely any alteration upon it; for, by the laws which regulate vitality, it happens that the excitement of the system can, in no instance, be urged above its accustomed and natural pitch without this being succeeded by a correspondent degree of depression. In prescribing, therefore, even for a male patient, at this period of life, the influence of sex in modifying the operation of medicines is not to be overlooked.

In the female, whatever may be the cause of that periodical determination of blood to the uterus which is termed menstruation, or whatever may be its ultimate intention, its presence or its absence produces a very considerable difference in the operation of various medicines. Thus, preparations of Iron, which generally operate beneficially in rousing the energy and promoting the tone of the system in pale leucophlegmatic females, when the menstrual discharge is either obstructed or deficient, would prove deleterious in strong young women, in whom this excretion is regular and in sufficient quantity. In pregnancy, many diseases may supervene; but the remedies which relieve similar diseases in females who are not pregnant, cannot always be employed with safety. In the unimpregnated female, the irritable state of the stomach, which is accompanied with heartburn and vomiting, may be judiciously managed with sedatives; such, for instance, as the Hydrocyanate of Potassa; but, in the pregnant state, as this salt, when given to the mother, has been detected in the fœtus, much injury may accrue to the unborn infant from its administration, either in full or frequently repeated doses. Opium, also, when given in large doses, if frequently repeated, for the relief of cramps or inquietude in the mother, is ultimately injurious to the fœtus. To the mother, also, these medicines may prove hurtful, from their action being modified by the disturbed state of the functions of the brain, which so often occurs during the period of pregnancy. For the same reason, some stimulants which may

prove highly beneficial in palsy, in the ordinary state of the body, often increase the complaint, and even tend to produce a fatal termination of that affection, in the pregnant female. The operation of many other medicines are equally modified by this state; and, indeed, no violent medicines can be safely prescribed for a pregnant female; nor should the *hot* bath ever be used in pregnancy.

In the nursing female the course of the circulation is different from that in the virgin and the woman who is not nursing. The blood is sent to the breasts in much larger quantity in a given period; the uterine functions are suspended; menstruation rarely occurs; and impregnation seldom takes place at this time. As the breasts also become excretory organs in this condition of the habit, the exhalant function of the skin, and the excretory of the kidneys, are necessarily greatly diminished; whilst the absorbents act more powerfully: and, thence, the female who has an abundant supply of milk, becomes thin in the direct ratio of the quantity. In this state, those medicines, which in females who are not suckling pass into the circulation, and are thrown out of it by the kidneys, are found in the urine in much less quantity than usual; and, therefore, it has been presumed that they are excreted by the mammæ, and *might* be detected in the milk. That odorous substances enter the milk is well known by the peculiar smell and flavour communicated to it in the cow who is fed upon decaying Turnip tops and on grains; but, as I have already said, I am not aware of any experiments that have detected, in the milk, either *Alkalies*, or *Rhubarb*, or *Iodine*, or any other substances the presence of which has been detected in the urine; nevertheless, it is not impossible that they may be found in the milk after they have been taken into the stomach of a nurse; and, therefore, some caution is required in prescribing, for nursing females, medicines that are of a nature likely to injure the health of the child in the event of their being absorbed and carried into the circulation of the mother. Were the medicines numerous which are thus absorbed and excreted by the mammæ, an easy and safe method of acting upon the infantile system in many diseases would be afforded.

EFFECTS OF CUSTOM IN MODIFYING THE ACTION OF
MEDICINES.

Nothing is more remarkable than the influence of *Habit* or *Custom* over both the *mental* and the *corporeal* functions in man; and its controul over the action of medicinal substances is not less wonderful.

The influence of habit over mind regulates, in many instances, the action of medicines; and, therefore, it is necessary to examine the manner in which it operates. If the vital principle be not simply a quality of matter, there can be no doubt of the distinct existence of the *Soul* or *Mind*—an essence which exists independent of organism, which, in every form and state of the body, in deformity, in defectiveness of parts, in disease, in age, in the almost total wreck of the corporeal frame, displays itself entire and unimpaired, triumphing over the frailties of our grosser nature. But in admitting this truth, we must also admit that the mind is so intimately connected with the animal functions—those of the *brain*, of the *spinal cord*, and the *nerves*—that, without these parts of the frame, it has never displayed its energies, and every *idea* is thence necessarily preceded by and dependent upon some corporeal change; nevertheless, the immediate cause of the *idea* thus excited is, in every instance, an affection of the immaterial mind. The nerves are the media of connection between the mind and the exterior world. Stimulants applied to the body produce, by the impressions which they make upon the nerves, certain effects which the mind perceives or takes cognizance of; and thus it becomes furnished with *ideas*. As these impressions, however, are not all alike, either as regards intensity or kind, *Memory*, or the principle of previous association, operates to retain and recall the marks of those already perceived, and *Judgment* to compare and examine their relations with those which are new or are to come. By means of these two faculties of the mind, therefore, aided by *Reason*, which enables us to draw inferences from the comparisons of the judgment, man becomes fully acquainted with the external world, and exerts

his influence over it. Now, it might be supposed that as long as the organs of the *senses* and the mental faculties remain entire, the judgment could not err in deciding upon the evident qualities of objects of sense, those in particular which we perceive by *touch*—as, for example, *figure*, and whether a body be *hot* or *cold*; or those which we examine by our muscular frame—*hardness*, *softness*, and *ponderosity*. But even over this decision, habit exercises a powerful controul, and often leads us to pass a judgment contrary to the conviction of our senses. This is well illustrated by an anecdote, which is related by Dr. Paris.* An eminent Chemist, when first he was shewn Potassium, the simple base of the Salt called Potassa, seeing that it resembled a metal, said, balancing the specimen on his finger—"It is certainly metallic, and very *ponderous*!" Here the habit, acquired from his past experience, of believing that all metallic bodies are heavy, compared with other bodies, controuled his judgment; for Potassium is so light that it swims upon water. There would have been nothing remarkable in this decision, if he had not called in, to the aid of sight, the evidence of his muscular frame, to determine the ponderosity of the specimen; for it is the true nature of induction to draw a conclusion from a great variety of instances, in which we have observed a like union or succession of similar phenomena, without having discovered any exception to this arrangement. In all other metals which this chemist had examined, those appearances had been perceived that authorized him to conclude, that *Potassium* is a metal; but when he weighed it and pronounced a judgment respecting its ponderosity, the powerful influence of *habit* controuled the decision; and he became incapable of distinguishing the deficiency in the series of arguments between the known metals which were familiar to him, and that which he then, for the first time, examined. This influence of habit upon the judgment modifies the operation of medicines, occasioning frequent disappointments to the physician, who, nevertheless, may sometimes take advantage of it for the benefit of his patient.

* Pharmacologia.

The immediate controul of habit over the body is still more evident than its influence through the medium of the mind. Its power in diminishing the sensibility of the nervous system has been frequently observed, and is well illustrated by a fact mentioned by Boerhaave, that when Hungary water was much in vogue, many women in Holland lost their sense of smell by the too great use of this water. But it is more difficult to explain how the vital or organic sensations, those which in the ordinary condition of the healthy body are independent of the will; the circulation of the *blood*, *respiration*, the evolution of animal heat or *calorification*; *digestion*, *nutrition*, and *absorption*; are influenced by habit: but the fact is undoubted. In an individual who is unaccustomed to *exercise*, the circulation is quickened by every slight exertion; but if the person continue daily to exercise himself, this effect ceases to follow even a much greater effort. In respect to the respiration, the power which pearl-divers possess of remaining under water is truly astonishing. No man who has not been trained to diving, can live under water, when the respiration is completely suspended, for more than half a minute, unless fainting has previously taken place, in which state even submersion in water can be sustained for upwards of a minute with impunity. Percival, in his history of Ceylon, says that the Pearl-divers at Condatchy sometimes remain five minutes under water. But, admitting that this statement is exaggerated; for Cordiner in his account of the fishery, says that they have never been known to exceed two minutes; yet, the power of remaining two or three minutes under water, which is frequently done by the oldest divers, in the Bay of Naples, shews in a remarkable degree the influence of habit. We have daily instances of the high temperature which the body acquires the power of supporting. Not to mention the individuals who have occasionally exhibited themselves, we may refer to the writings of Du Hamel, who mentions, among other instances, that the young female servant of a baker at Rochefoucault had acquired the habit of resisting heat so effectually, as to go into an oven heated at 276° , and to remain in it for twelve minutes. In general, the hot bath cannot be borne at a higher temperature than 106° ; but the Russian,

who is in the daily habit of using it, can support it at 116° ; and when a vapour is employed instead of water, habit enables the Russian to bear it as high as 160° . The same power enables cold to be sustained without danger. Thus, we see women of the most delicate frame, with the shoulders and chest exposed in a manner that could not be borne without great risk by the strongest men unaccustomed to it. The peasants in the north of Europe go with their bosoms bare in the coldest winter weather; and the companions of Captain Parry in his voyage to the North Pole, after some time, used to walk on the shore when the thermometer was 49 degrees below Zero. With regard to digestion, I need only mention that the Siamese are fond of rotten eggs, and digest them readily; although I need scarcely say, that nothing would be so likely to disorder the stomach of any one who has not acquired the habit of relishing such food. In this manner we might trace the influence of habit over every vital function.

In modifying the direct effects of medicinal agents upon the body, the power of *habit* is equally conspicuous. If the same medicine be daily administered for some time, instead of being followed by the result which at first displayed itself, the system remains unsusceptible of its impression; and yet, the properties of the medicine remain unimpaired, and the condition of the parts upon which it acts remains also unchanged. This is rendered evident by substances applied to any other part; for example, the substance which has ceased to act on the stomach will still operate briskly if administered as an Enema; and it will not require a larger dose of Arsenic to destroy an opium-eater than any other person. But even poisons are rendered inert, if their administration be carefully regulated, by commencing with small doses, and daily augmenting them, watching their effects lest the increase should be too rapid. Many persons have thus brought themselves to swallow opium in large quantities without feeling its narcotic effects. I have known instances in which two drachms of solid Opium or five fluid ounces of Laudanum have been taken in twenty-four hours; yet the same individuals could not have swallowed many grains of it without danger when they commenced the bane-

ful use of the drug. In this same manner we find that habit renders the nerves of smelling callous to some odours, while they retain the greatest susceptibility to others. Thus, Baron Haller was not at all affected by the stench of a dissecting room, yet he was peculiarly sensitive in distinguishing, even at a distance, a fœtid perspiration, when it was scarcely sensible to any other person. If we attempt to account for the effect of habit in the instances just described, by saying that the repeated application of the same stimulus to the body diminishes its power on the sentient extremities of the nerves, owing to these retaining for a certain time the change which the impression of the stimulus produces—and, therefore, the application of the same substance, unless in greater quantity, becomes incapable of altering this condition, but rather confirms it—thence the repetition of the impression will ultimately cease to produce any effect, even in degree—what do we say more than merely state the fact? We do not advance one step in raising the veil which obscures the cause from our perceptions. The knowledge of the simple fact, however, is sufficient for our purpose: it convinces us of the power of *habit* in modifying the operation of medicines, independent of the mind; and demonstrates the necessity of the physician enquiring into the habits of a patient previously to prescribing any medicine, from the operation of which much is to be expected. Thus, if a person, who is in the habit of taking Opium in large quantities, is labouring under a disease in which pain and watchfulness are symptoms, although it would be useless to prescribe Opium, yet the indication might be answered by a moderate dose of another narcotic. Illustrations of this fact more frequently come under the observation of the physician in reference to purgatives and some other classes of remedies than to narcotics. In persons, for example, who are in the custom of taking pills composed of Colocynth and Aloes, or similar articles, the largest doses of these purgatives occasionally fail, under disease, to produce the action of the bowels; whilst a desert spoonful of Castor Oil, or a teacupful of sea water, will produce copious and numerous evacuations.

In stating these facts, it must also be mentioned that

habit does not always obtund, if I may so express myself, the susceptibility of impression to the same stimulus; for this results from those stimuli only, with the exception of a few, the action of which falls short of inflammation or of spasm. A man may take a large quantity of diluted Alcohol, day after day augmenting the quantity, and yet scarcely feel its effects; but one glass of pure Alcohol would produce inflammation in the stomach, which would be farther increased by a repetition of one tenth even of the original dose. No habit can reconcile the body to impressions of such a degree as produce a state of disease.

I have said, that some stimuli, the operation of which falls short of actual inflammation, are exceptions to the general rule, and, instead of producing a diminished effect by repetition, have their influence augmented. This augmentation of effect, however, is extremely irregularly displayed: thus, if Tartar Emetic, in doses of from six to ten grains, be given at intervals, for several successive days, it causes at first vomiting, purging, and sinking of the pulse: these symptoms disappear on the second or third day; but, after the fifth or sixth, the influence of the medicine is again displayed in a new manner; the appetite is completely extinguished; there are constant eructations, with great anxiety, a shrinking of the body, and pallidness of countenance. Castor Oil demonstrates the fact again in another manner. After this medicine has been taken for some days regularly, in the full dose, the quantity may be gradually diminished without impairing its effects, until, from six drachms, the dose is decreased to as many minims. The advantages to be derived from habit in modifying the action of this medicine and many others ought not to be lost sight of. In prescribing Castor Oil, in cases of habitual costiveness, we must ascertain whether the patient has been in the habit of taking the medicine; as the dose which would, in ordinary cases, be a very moderate one, might, in the instance of a person habituated to the use of the medicine, prove of serious disadvantage.

The inferences to be drawn from the above facts, are the necessity of augmenting the doses of medicines, when it is re-

quisite to continue them for some time, and, also, of occasionally suspending, for a short period, the use of a medicine ; so that, when it is again employed, the impression may be renewed with sufficient energy.

INFLUENCE OF CLIMATE IN MODIFYING THE ACTION OF MEDICINES.

The influence of climate, in modifying the action of medicines, operates in two ways: 1. By the change which climate causes in the animal frame: 2. By the changes which it occasions in medicinal agents of a vegetable origin.

Effects of climate on the animal body.—Man is the only animal that can live in every climate: but, although he can live, yet changes are effected on his frame and constitution of the most striking kind, by removal from one part of the globe to another part; and these are not temporary, but are continued through many generations: this constitutes the varieties of the human race. In employing the term *varieties*, it is right to mention, that naturalists are divided upon this question. Some, among whom is the justly celebrated Buffon, make one species only of man; others maintain that there are several species; whilst a third set, steering a middle course, suppose that, although there be not distinct species, as of the lower animals, yet, that there are distinct *races*. The most celebrated of modern naturalists, M. Cuvier, is the chief of this opinion. I have not the presumption to rank myself as a combatant under any of these leaders; but I may venture to say, that every fact in the history of mankind, with which I am acquainted, tends to confirm me in the belief, that *man is of one species*, and that the *whole* of the human genus is descended from the *same original parents*. The proof of this may be drawn from the traditions of almost all countries agreeing, as far as concerns the birth place of the first parents of our species. Moses fixes it in the south of Asia; the Hindoo traditions state that their progenitors came from the north-west; the Scandinavian, that theirs tra-

velled from the south-east ; and the Chinese assert that their ancestors came from the west : all concurring to fix on the spot pointed at in the Mosaic writings.

It might be very plausibly asserted, that man came perfect from the hand of his Creator ; and that the *races* and *varieties* of the species are the result of various causes operating a *degeneration* ; or, in language more easily understood, a *deviation* from the original standard. Before proceeding, it may be proper that I explain my meaning of the words *race* and *variety* : and, in doing so, I cannot adopt a better definition than that of the celebrated *Kant*, the German Metaphysician, who regards the term *race*, as strictly applicable only to a character produced by degeneration, and such as to become, by propagation, necessarily and inevitably *hereditary* ; as, for instance, the sexual intercourse of a *white* man with a *Negro* woman, produces a distinct race, the *Mulato* : on the contrary, the term *variety* is applicable to such variations as occur when *fair* individuals, connected with *brunettes*, propagate *dark-eyed* children. When *races* have been continued through a long series of generations, they almost acquire the fixed characteristics of distinct species ; and it is this which has involved the question of the human family in so much obscurity. The causes of the degeneration, of which I have just spoken, are very numerous : the chief are *climate*, *food*, and the *modes of life*, of associated mankind. Thus, if the tall and symmetrical *Georgian* be transported to the *Arctic* circle, in a series of generations his progeny would dwindle into the diminutive and stunted *Esquimaux* ; in the same manner as the noble tree, spreading forth its luxuriant branches in the valley, appears of dwarfish stature and little more than a shrub when its seed, carried by the wind, or from other accidents, vegetates on the height of the mountain. It would be out of place, here, to enter minutely into all the proofs which support the opinion of the mono-species of mankind. I will merely remark, that it is founded on Scriptural History, and chiefly supported on the physiological characters common to all the races ; on the facility with which these pass into one another ; on the power of the mixed progeny of any two of the races to propagate ; and on the diversities of the races

being in all respects analogous to those deviations from a common type which mark varieties in the progeny of a single race. It is, nevertheless, probable, that the changes which constitute the races are not altogether accidental; but that there is, as Dr. Prichard remarks, “an *intentional* relation to climate in the distribution of the different races.” It is in the form of the head or skull, that these distinctions are chiefly observable: thus, the great breadth of the head in Asiatics, compared with the narrow flattened head of the Negro, and the oval skull of the European, is obvious to the most cursory observer; and upon this feature, some philosophers, particularly Blumenbach, have attempted to arrange all the races of the human species under different heads. Blumenbach, following Lacedede, makes five distinct *races*; the limits of each of which can be easily traced upon the map of the world. Two of these races, however, may be regarded as varieties of the other three: in noticing them, I will not enter into the peculiarities that distinguish each, beyond a general outline.

1. The *Caucasian*—named from Mount Caucasus, in the neighbourhood of which the Georgians and Circassians, the finest race of man, is found—is distinguished by the skin being white and the cheeks florid; the hair long, soft, and undulating, varying in colour, from a nut-brown to the deepest black; the head nearly globular, with the forehead moderately expanded; the cheek bones narrow; and the front teeth of each jaw placed perpendicularly; the face oval; the nose narrow and prominent; the mouth small; the lower lip turned out, and the chin round. This variety is supposed to be the standard of the human race; and some authors have devised means of determining its perfection. It comprehends all Europeans, except the Laplanders and the Finnish race, takes in the western Asiatics as far as the Obi, the Caspian sea, and the river Ganges, and the people of the north or Mediterranean coast of Africa.

2. The *Mongolian*—or Tatarian, marked by the skin being pale olive; the hair thin, black, stiff, and straight. The head is square; the cheek-bones are prominent; the eyes are far apart, the eyelids half closed and apparently tumid,

the arch of the eyebrow is scarcely perceptible; the osseous nostrils are narrow, and the chin is somewhat projecting; the face is broad and flattened; the cheek projected outward and nearly globular; and the nose small and flat.

This race takes in the remaining Asiatics, except the Malays; it includes the Finnish races of the north of Europe; the Laplanders and the Esquimaux.

3. The *Æthiopian*—distinguished by the skin being brown, black, and yellow, and the hair black and crisp. The head is compressed laterally; the forehead arched; the cheek-bones projecting, and the nostrils dilated; the malar fossa, behind the infra-orbital foramen, deep; the jaws lengthened forwards: the front teeth obliquely prominent, the lower jaw large and strong; and the cranium thick and heavy, and comparatively less capacious than that of the Caucasian race, as its cavity will not hold so much fluid as that of the skull of a European, by from four to nine fluid ounces. Thence it is maintained that the intellectual faculties of the African are less than those of the European, in proportion to the capacity of the brain. The face is narrow and projecting at its lower part; the eyes are prominent; the nose is broad and flat: the lips, particularly the upper, are thick; and the chin is receding. In this race the facial line differs greatly from that of the Caucasian, and seems to be the intermediate between that of the man of the latter race and that of the Ourang-outang.

This race is spread over the whole of Africa, with the exception of the northern shores.

4. The *American*.—The skin in this race is of reddish tan, or copper-colour; and the hair thin, black, stiff, and straight. The forehead is short; the cheek-bones are broad, arched and round; the orbits are deep; and the cranium is light; the face is broad, with distinctly marked prominent cheeks; the eyes are deep-seated; and the nose is only moderately projecting.

It comprehends the Indians of the whole of the continent of America, except that portion which is occupied by the Esquimaux.

5. The *Malay*—is distinguished by the skin being tawny,

or a clear mahogany, or chesnut-brown; by the hair being black, soft, curled, and very abundant. The head is somewhat narrow; the forehead slightly arched: the parietal bones are prominent; those of the cheek flat; and the upper jaws projecting; the face is broader than that of the *Æthiopian*, but the features viewed in profile are more distinct; the nose is full, broad, and knobbed at its point; and the mouth large.

It embraces the inhabitants of the whole of the islands of the Pacific ocean, of the Marian, Phillipine, Molucca, and Sunda Isles, and of the peninsula of Malacca.*

The division of the Human Species into five Races, by Blumenbach, is ingenious, but it is liable to exceptions. The different varieties run so insensibly into one another, that it is impossible to mark out the exact boundaries of the commencement or the termination of any of them. I cannot avoid quoting a striking remark upon this subject from the work of Drs. Martius and Spix on the Brazils. "The physiognomy of the Chinese colonists was particularly interesting to us," observe these gentlemen in their account of Rio Janiero; "and was in the sequel still more so, because we thought we could perceive in them the fundamental lines, which are remarked in the Indians." These they describe, and then add, "In comparing the Mongul physiognomy with the American, the observer has opportunity enough to find traces of the series of developments through which the Eastern Asiatics had to pass, under the influence of the climate, in order, at length, to be transformed into an American." Indeed, to the attentive observer, in any part of the world, the characteristics of several of the races are often found in the same individual. There are many Europeans who closely resemble the African or the Mongul, in every respect except colour: nor is this resemblance of individuals of one race to other races peculiar to countries in which opportunities for mixing and crossing breeds exist; but it is ob-

* Cuvier acknowledges three races only: the *white*, or Caucasian; the *Negro*, or *Æthiopic*; and the *yellow*, or Mongolian. I prefer the division of Blumenbach.

served also in those parts of the globe which are cut off, as it were, from all the rest of the world. Captain Cook, in his voyage round the globe, saw many nations of the Friendly Islands, who are of the Malayan race, with complete European faces ; and some even with Roman noses.

These varieties are regarded as the effect of climate. What is climate ? Geographers understand by climate any space distant from the equator and poles ; and, regarding the term in this sense, the old Geographers divided the hemisphere into thirty climates. For our purpose we must regard climate in a different point of view. It does not imply merely the geographical locality in reference to latitude on the surface of the globe ; but the elevation also of that locality above the mean level of the surface of the earth. Temperature, in this respect, operates almost as powerfully as it does in the relative position of a spot as far as regards its proximity to the equator. The inhabitants of a region elevated a thousand feet above the level of the sea live in a very different climate from those who inhabit its margin ; although both places may be in the same degree of latitude. Temperature, therefore, arising from the direct and the radiated beams of the sun, influenced by *latitude* and *altitude*, constitute climate. We feel all the varied degrees of temperature in passing from the equator to the pole ; and we feel them also in ascending from the valley to the summit of a lofty mountain. It may be proper to state here, that the heat or coldness of a climate is generally determined by taking the mean annual temperature. This, however, is not determined by observations of the various changes in the temperature of the atmosphere, as displayed by the Thermometer : but, as water, at a certain depth, is not liable to be affected by the changes of the atmosphere, the temperature of deep lakes is considered as indicating nearly the mean annual temperature of the latitude in which they are found. According to tables constructed by Mr. Kirwan, the mean annual temperature at the equator is 84° of Fahrenheit, that at the poles 31°, and that of London 52° ; but the mean annual temperature is varied by many circumstances, such as vicinity to the sea, the elevation of the land, and culture ; and thence the mean annual

temperature of places, in the same latitude, differs. Thus, for example, New York, in North America, is in the same latitude as Lisbon; but its mean annual temperature corresponds to that of the north of Germany.

It is not easy to determine upon what other local circumstances those alterations, of which I have spoken in the human body, as produced by climate, depend: yet it is not altogether upon the temperature even as far as colour is concerned; for many facts may be brought forward to prove, that, after a considerable lapse of years, men who have migrated from the temperate regions of the earth to intertropical climates, have not become of so dark a hue as the natives of these countries. A race of Jews, which is known on the coast of Malabar by the name of white Jews, and who, from documents in their possession, appear to have emigrated to India soon after the destruction of the Temple of Jerusalem by Titus in the year 490, still resemble European Jews in features and in complexion.

With respect to the influence of either casual or permanent varieties of the species on the operation of medicines, there can be no doubt. The slender and delicate Hindoo, who lives entirely on vegetable food; the Esquimaux who gorges himself with the flesh of the seal or the blubber of the whale, until he is unable to move; the Otomac of South America, who, during the period of the inundations, appeases his hunger with unctuous clay; and the English yeoman, who satisfies himself daily with beef and porter, to his heart's content; will all be variously affected by the same medicines. But climate, independent of these variations, effects a change of the constitution of the same individual, and thus, also, influences the operation of medicines.

Dr. Davy, in his travels in Ceylon, states, from his personal observation, that, on first landing in a tropical climate, the standard heat of the body of a European is raised two or three degrees; and febrile symptoms occur, which require temperance, the avoiding every cause of excitement of the vascular system, and the use of aperient medicines. All authors, and indeed every observing person who has visited the torrid zone, agree that, with the languor and exhaustion

resulting from the high temperature of the atmosphere, there is a greatly increased mobility of the nervous system. The action of the cutaneous vessels amounts to disease, and produces that eczematous or vesicular eruption of the skin, known by the name of prickly heat, which occurs in Europeans who visit the West Indies, on their first landing. On the other hand, this function of the skin is so much weakened, almost paralyzed, when the climate from which a person is passing is dry and bracing, and that into which he has passed is humid and relaxing, that congestions of blood take place in the larger vessels; the body becomes susceptible of the least impression of marshy exhalations; and agues and similar diseases are produced.

It may be also mentioned, that the diseases of the Torrid Zone are those of *irritability* and *sensibility*; the diseases of the Frigid Zone are the reverse, arising from the deficiency of the stimulus of external heat, and a lack of *excitement* in the whole system. In this state of habit, the powers of the stomach are impaired; and, therefore, stimulants are taken with impunity. In the Torrid Zone, also, or countries bordering upon it, the peculiar currents of the air greatly affect the human system. Thus, the sirocco, the wind which blows from the great Sahara, or African desert, seems to leave behind it a portion of the *oxygen* of the atmosphere; for, during the blowing of that wind, in Egypt, and even in Italy, fires do not burn well, the breathing of animals is oppressed, vegetation languishes, and so much debility is caused in man that, during its continuance, the use of sedatives is absolutely prohibited.

Although man is the only animal who can live with impunity in every climate, yet this refers only to the adult, who has been nurtured to manhood in the climate peculiar to his variety of the species: his progeny, when he removes to another climate, may fall victims of the removal. Thus, the children of European parents, born in intertropical climates (India, for instance), seldom live to attain adult age if they remain in the country; although, when one of the parents is a native, they do not suffer. I cannot avoid noticing, in this place, a curious fact recorded by Volney, the eloquent histo-

rian of Egypt, that neither the Mamlouks, who were a *Caucasian* race, nor the *Turks*, who are Mongolians, unless they married native women, which the Mamlouks never did, could continue their race in Egypt; all their offspring perishing in the first or second generation.

The effect of climate on the progeny of those who migrate to distant countries is well illustrated by many instances affecting our own countrymen. Thus, the Creoles of the West Indies, the inhabitants of the United States of America, and the settlers in New Holland and Van Dieman's Land, are all derived from the same English stock, and yet all their progeny differ from it in some peculiar feature. The *Virginian* and the man of *Carolina* are tall, lank, and gaunt; the West Indian Creole is distinguished by a singular configuration of skull; and, in New South Wales and Van Dieman's Land, the children of even diminutive European parents grow up tall and spare; and, nevertheless, the natives are a short race of mankind. In moist climates, obesity and laxity of frame are induced—a fact which was very early observed: thence the proverbial acuteness of the Athenians, and the sluggishness and stupidity of the Bœotians. The effect of situation upon the state of the habit may, in some degree, depend also on the gravity or weight of the atmosphere, connected with locality. When the barometer is high, we feel vigorous and cheerful; when it sinks, languor and low spirits oppress us. Asthmatics on this account, sometimes, breathe with more freedom in a dense atmosphere, and, therefore, find comfort near the sea.

That climate should produce such alterations upon the human race will, perhaps, appear less remarkable if we examine those which it effects on the lower animals. I will mention a few instances only of these. Sheep, in cold and mountainous districts, are thickly covered with fine, soft wool, which, involving much air, is a bad conductor of the heat generated in the body of the animal: the same breed of sheep, in intertropical regions, furnish only stiff, coarse hair. The swine of the island of Cuba are twice the bulk and stature of the European breed from which they are descended; and, even in Normandy, the bristles of the hog are so soft as

to be unfit to make brushes. On the coast of Guinea, not only the human species, but the dogs and the gallinaceous fowls, are black. In Corsica, the horses and dogs are spotted in a peculiar manner*.

Seeing the influence of climate in producing such alterations as those I have described on the aspect and habits of the human species, and on the tribes of the lower animals, it will be easy to form an idea of the power which it is likely to exert in modifying the operation of medicines. The late Dr. Harrison found that *Narcotics* act with greater force, even in smaller doses, in Naples than in England. He instances the Extract of Henbane, which, in doses of three grains, thrice a day, at Naples, produced a temporary *amaurosis* or *nervous blindness*, which disappeared and recurred on the alternate suspension and administration of the medicine. This effect of the Extract was observed in two patients, who had often taken similar doses of the same remedy in England, without any unpleasant result—an effect which Dr. Harrison correctly refers to the increased nervous susceptibility of impression of the patients, in the warmer climate. It might be supposed that the Italian extract is more powerful than the English; but that argument would not apply in this instance, as the medicine which was administered in Italy was procured from London; consequently, any increase of its power could not be attributed to the influence of climate on the medicine itself. Dr. Harrison found, also, that Nitrate of Silver and Nitrate of Mercury are more active in Italy than in England; and that, in general, the doses of medicines ordered in this country are too large for the climate of Italy. It does not, however, always follow that the doses of medicines require to be reduced in warm climates: on the contrary, in India, a scruple of Calomel and a grain of Opium are frequently administered, and repeated at short intervals, after depletion in dysentery; but few physicians would venture to prescribe this active remedy, in such large doses, in this climate.

* Those who wish to extend their enquiries regarding the varieties of the human races will find much information in Blumenbach "De Genere Humani Varietate Nativa," and in Dr. Prichard's Physical History of Mankind.

But even the state of the weather and the season of the year will, sometimes, alter the action of a medicine, in the same country. Thus, Mr. Annesley, in his work on the Diseases of India, informs us that, in the subsidiary fever of Nagpore, the Cinchona Bark, although the grand remedy in the cold season, yet generally fails in the rainy reason; at which time Calomel and Antimony prove beneficial.

The neglect of observing the effects of the influence of climate in modifying the action of medicines has led to many of the discordant accounts of remedies by different writers, and the rejection of many valuable medicines. Many medicines, also, have been unjustly depreciated from having been administered at improper seasons of the year, or from no allowance having been made for the power of local circumstances over their action in the animal œconomy. An example of this description is found in the *Rhododendron Chrysanthum*, which has been very successfully employed for the cure of rheumatism in Russia, but has greatly disappointed the hopes of practitioners in this country. This failure has been attributed to the plant suffering from drying and export; but the cause is more likely to be found in the effect of climate upon the constitutions of those to whom it is administered. We may, also, refer to the same cause the greater efficacy of Guaiacum in Hispaniola and other warm climates, in curing syphilis, than in Europe. In treating of the different articles of the *Materia Medica*, I shall have frequent opportunities of illustrating the truth of this remark. In prescribing for those who have lately arrived in a country of an opposite climate to that from which they have come, and who have not had time to be naturalized to it, the knowledge of the above-mentioned facts will be found useful. Thus, in the case of a person who has arrived in a hot from a cold climate, the susceptibility of impression being greatly augmented, the habit acquires a febrile tendency, and will not admit of the same doses of stimulant medicines that may be given with advantage to natives of the place, and to those accustomed, from long residence, to the climate. Such are the effects of climate upon the animal frame, and its consequent influence on the operation of medicines.

Climate also produces changes upon the vegetable tribes as striking as those upon the animal. It is supposed by Dr. Prichard "that the vegetable creation was originally divided into a number of different provinces. Each country, perhaps each chain of mountains, had its peculiar tribes of plants, which at first existed not elsewhere;" and that from these, as from a centre, each kind spread in various directions over the surface of the globe. There is much ingenuity in this supposition; but, as the same plants are, also, found in very distant countries, in the same latitudes, it is as probable that they were originally scattered over the globe, in bands within certain latitudes, adapted by temperature to their nature, and by soil to their nourishment. Some plants, indeed, have an entirely isolated and local existence; being found naturally on some particular spot and never elsewhere. In whatever manner they were originally disposed, or have been since naturally diffused, man, endeavouring to bend Nature to his control, has naturalized plants to climates very opposite to those in which they were originally found. In this attempt, however, plants, like animals, feel the influence of climate; and, consequently, medicines of a vegetable origin have their active powers more or less changed, if removed from the spots where Nature had planted them, to be cultivated in foreign soils. This is, indeed, an almost insurmountable obstacle to the naturalization here of medicinal plants of latitudes greatly different from that of England. In general, the virtues of the plants are diminished, if not totally destroyed, by the transportation.

The effect of climate upon the medicinal properties of plants is strikingly illustrated in the history of the Meadow Saffron, *Colchicum Autumnale*. In England and many other countries, the *Colchicum* always contains an acrid, alkaline, bitter principle, *Veratria*, of great importance as a remedy, and a virulent poison when overdosed. At some seasons of the year, the bulb of the *Colchicum*, in this country, is more active than at others; but, during the whole year, it contains a sufficient portion of its medicinal principle to render it a very hurtful substance if eaten as food: yet, in other parts of the globe it may be eaten with impunity at some seasons. Kraterhvil, a German author, in his work "de Colchico," relates instances

in which entire bulbs were eaten without any bad effect being produced on the habit. Krapf, another German writer, says that he has eaten the bulb with impunity in autumn, and that it is then eaten in Carniola and Istria: yet autumn is the period of the year when the bulb is most active in this country. The celebrated Haller, also, avers that it is both tasteless and inert in autumn. Now to what are we to ascribe those peculiarities in the *Colchicum* of the countries in which these writers lived? Their veracity is undoubted; yet their relations are at direct variance with our experience in this country, and, therefore, we can only ascribe the difference to climate and to local circumstances. For the same reason *Senna* transported from Upper Egypt and grown in the South of France varies both in the external characters of the leaf and in its purgative properties: the leaves are more obtuse, less bitter and less nauseous when chewed, and much less purgative than the Egyptian *Senna*. The tree named *Myrospermum Frutescens*, when it grows in New Grenada, yields *Balsam of Tulou*; but when it grows in Peru it yields a very different Balsamic substance; which, from the place of its production, has been named *Balsam of Peru*. I may also mention that Mint, and many other plants which yield an essential oil, afford it of a much less penetrating odour in the South of Europe than in England: and, it is a curious fact, that almost all strong smelling plants lose their odours in a sandy soil.

From these facts, it is very obvious that the nature of the climate in which medicinal plants are cultivated should be known. Indeed so very important is it that medicines should always be as nearly as possible the same, that a medicine coming from any other part of the world than that from which it was originally obtained ought not to be trusted in the cure of diseases, until a set of comparative experiments have determined its affinity in every respect to the original drug.

Cultivation has a close resemblance to climate in its effect upon the medicinal properties of plants. Few plants which are medicinal admit of cultivation, although edible vegetables are greatly improved by it. In the cultivation of edible plants the object is to increase the proportion of feculent and farinaceous matter in roots, in tubers, and in bulbs; and

consequently, if any acrid or active principle which they may contain be not proportionally augmented, the same weight of the root, tuber, or bulb, must necessarily be less active, in the direct ratio of the diminution of the quantity of its acrid principle in proportion to the increase of its farinaceous part. Another object of the horticulturist is to convert the simple flowers of nature into the more showy inhabitants of the parterre by doubling them, as it is termed; that is, converting the generative organs into petals; or, in compound flowers, the disc or tubular florets into what are termed ligulate. Thus, for example, the Chamomile, *Anthemis nobilis*, is often doubled; but as the medicinal virtue resides chiefly in the disc florets, the conversion of the natural flower into the double variety greatly deteriorates the strength of the remedy.

Besides the modifications in the properties of medicinal plants produced by climate and culture, other circumstances contribute to vary or alter their powers. Thus all medicinal plants do not acquire their active qualities until they have attained what may be termed adult age: even poisonous plants may be eaten with impunity when they are young. Some plants, again, have their active principles suddenly developed at a fixed period of their existence: the Lettuce, for example, when young, possesses scarcely any of the narcotic principle which constitutes the Lactucarium of the Pharmacopœias, although it is abundantly secreted at the flowering season. In the Poppy the narcotic principle is scarcely apparent until the petals fall and the germen enlarges. The soil also, its dryness or its moisture, the degree of exposure of the plant to heat, light, and air, all contribute to modify its medicinal qualities; and, thence it happens that plants collected in one year may display great activity, whilst in the next they may appear almost inert. A plant which grows naturally in a dry or an absorbent soil is generally less active when it is found growing in a humid or a marshy situation: another which is the ordinary inhabitant of an exposed spot, and requires the invigorating influence of the stimulus of much light, heat, and air, languishes and loses its medicinal virtues when it rises accidentally in the forest; whilst others, again, only acquire them in the shade. It is, indeed, these circumstances, in a great measure, which distinguish

climates, and which augment the remedial properties of vegetable bodies that owe their activity to volatile oil, resin, and the balsams. The knowledge of these facts is of great importance to the collectors of medicinal plants; who should be able to determine the period in the life of a plant, the nature of the soil, the degree of exposure, and the season of the year most favourable to the development of its active properties.

INFLUENCE OF MENTAL AFFECTIONS IN MODIFYING THE ACTION OF MEDICINES.

In examining the influence of the mind in modifying the action of medicinal agents, the questions—What is mind?—What is matter?—naturally present themselves to our attention. To reply to these queries involves enquiries of much difficulty, and uncertain utility; and to attempt to treat either of them at great length, or metaphysically, would be out of character with the object of this work. Indeed, to venture to form any decision as to the real nature of either mind or body displays only that presumption which has always characterized attempts to resolve problems which from their nature seem placed beyond the grasp of human reason. But as some ideas are necessary on the distinct nature of mind and matter, instead of entering the labyrinth of metaphysics, let us make our appeal to common sense.

If we discourse of *matter*, we cannot demonstrate that we have a positive perception of substance; but we perceive its qualities—*extension, figure, colour, solidity*: and this, as Dr. Reid expresses himself, from the constitution of our nature, leads us to refer to something which is extended, figured, and coloured. In the same manner, although we have no distinct evidence of the existence of mind, yet we are conscious of *sensation, thought, and volition*; and this at least implies the existence of something which feels, and thinks, and wills. Every man feels that his sensations, thoughts, and volitions belong to a part of himself which is distinct from his body; for, if he lose a leg, or an arm, or both, or all his legs and arms, this feeling,

thinking, and willing part of his being is as vigorous as ever : he has a clear demonstration therefore that it is not a material substance, nor the result of material organization, since it is not liable to be impaired by the loss or mutilation of many of his organs. It may, however, be said that we have not so strong an evidence of the existence of mind as of body ; but a little reflection will convince us that this is an error, since, to use the language of the eloquent Dugald Stewart, “the one is suggested to us by the subjects of our own consciousness, and the other merely by the objects of our perceptions.” If this be correct, the establishment of the distinction between mind and matter requires no process of metaphysical reasoning ; our notions of both are merely relative : “we know the existence of body, of *matter*, only by such sensible qualities as *extension*, *figure*, and *solidity* ; that of mind by such operations as *sensation*, *thought*, and *volition* : both are known to us only by qualities and attributes ; of the essence of either we must confess that we are totally ignorant.” Having these remarks before us, let us now examine how far the operation of medicines on the body is influenced by this *feeling*, *thinking*, and *willing* part of our being.

The powerful influence of mind over the functions of the body is well known to every observing physician. The facetious author of *Tristram Shandy* strongly expresses this fact when he compares the body and soul to a coat and its lining ; “if you rumple the one, you rumple the other.” This influence is exerted according to the nature of the passions ; which may be all arranged into two classes : the *depressing* and the *exciting*. Among the former we find *Vexation*, *Sorrow*, *Fear*, and *Terror* ; among the latter *Joy* and *Confidence*. All experience in the practice of medicine tends to convince us how necessary it is to be aware of the influence of these passions on the system of a patient ; not only at the moment when the physician is about to prescribe for him, but in observing the effects of the medicines prescribed. The body sympathizes with, or follows the affections of, the soul more in disease than in health ; it acts as the soul feels, and thence the influence of mind in modifying the operation of medicines.

a.—*Vexation* disturbs the function of the stomach, alter-

ing its natural secretion, the gastric juice ; and thus, by impairing its digestive powers, Vexation becomes a very common cause of dyspepsia or stomach complaint.

b.—*Sorrow* diminishes the energy of the nervous system, lessens the force of the circulation, impedes all the secretions, and finally induces organic diseases. The appetite and sleep become impaired, the blood is imperfectly changed, owing to its passing too slowly through the lungs ; flatulence, colic, spasms, display the altered functions of the stomach ; whilst that of the liver is evidently affected, as is displayed in the sallow, often truly jaundiced, countenance of the sufferer.

c.—*Fear* paralyzes the muscular powers of the body, weakens and even arrests the motion of the heart, so that a congestion of blood occurs in the central vessels, and the surface becomes pale. Philip the Fifth of Spain died suddenly on being told that the Spaniards had been defeated. The fear of the consequences was so great as to cause such a congestion of blood in the heart, that it burst the auricle, and produced immediate death. Indeed, so completely does fear sometimes exert its sedative effects, that Dr. Parry, in his *Elements of Pathology and Therapeutics*, remarks that he has seen it, in a few seconds, remove all the incipient symptoms of fever. Its effects upon the secretions are well known : it suppresses the catamenia, produces diarrhœa, sweats, and a sudden involuntary flow of urine. Fear, also, generally increases the danger and fatality of diseases. By lowering the powers of Nature, it so modifies the influence of remedies, as often to enable the disease to baffle the most judicious practice, and resist the most powerful medicinal agents. I have seen patients recovering from acute diseases suddenly thrown back by a sudden alarm regarding their condition ; and, in more than one instance, death has followed soon after this feeling took possession of the mind.

d.—*Terror*, which is an augmented degree of *Fear*, acts so powerfully on both the secretions and excretions, that infants, imprudently applied to the breast when the mothers are still under the agitation of some serious alarm, are liable to be seized with convulsions, owing to the change effected in the secretion of the milk by the fright. I had an opportunity

of witnessing, some years ago, the following striking illustration of the influence of mind over body. An officer in the army, a man of great personal bravery and a distinguished soldier, consulted me for the relief of a complaint which has hitherto baffled all the efforts of medicine, *pulmonary consumption*, in the last stage of which he was suffering. His love of the military profession, and that delusive hope of recovery which always accompanies this disease, led him to object strongly to the sale of his commission, although it was by such a measure alone that he could hope to leave his wife and his daughter, an only child, above the reach of absolute poverty. His wife, who knew his situation, and the necessity for his disposing of his commission, was nevertheless so much swayed by her affection, that she would not join in the persuasion of his friends and myself to take the necessary steps for obtaining the consent of the war office to effect the sale; and, therefore, it was not until he began to feel the truth of his situation that our wishes were acceded to. At length, a petition to the Commander-in-chief was drawn up; and a will, in favour of his wife and child, having been made at the same time, I was requested to be a witness to his signature of both instruments. I saw the deeds executed, and left him seated in bed, apparently more comfortable than he had previously been for weeks; but I had not left the house many seconds before I was recalled by the servant; and, on returning, found my patient dead. His wife was standing by the bed-side, erect but motionless. I spoke to her; she heard me not: I took her hand; the muscles were rigid and she felt not: there was no volition: her eyes were open, but they were staring upon vacuity; there were no obvious symptoms of respiration, no rising of the chest, no dilatation of the nostrils: she was warm, but the pulse was not perceptible: in short, she was in that state which is termed *ecstasis*; as inanimate as a statue; and, although living, yet as stiff and as rigid as a corpse. She continued in this condition for forty-eight hours; then recovered her power of volition and of speech; but she was not restored to her usual health for many months; and, during this time, her brain was seriously affected. Here, the torpidity of the body was the result of the

sudden transition from satisfaction to extreme grief; the mental cause operating upon the nerves nearly in the same manner, but in a more extended degree, as the irritation of a wound when it produces tetanus.

e.—*Joy*, on the other hand, operates as a powerful and exhausting stimulus on the nervous system. Many instances of its fatal effects are recorded. I need scarcely recall to the mind of the classical student the fate of Sophocles, who died on being crowned for composing a successful tragedy in his old age; nor that of Chilon of Lacedemon, who, whilst embracing his son, when declared victor in the Olympic games, died in his arms; nor the stories of the Roman ladies, who died on seeing their sons return from the battles of 'Trasymenus and Cannæ. A fact nearer home, and more to our purpose, is that related by Dr. Mead, that, in the memorable year of the South Sea bubble, more individuals went mad who acquired sudden fortunes, than those who were ruined by that speculation. Much of this effect of Joy on the nervous system is connected with temperament; the impulse that kills one man, will often scarcely rouse the smile of another.

f.—*Confidence*, on the same principle, acts as a tonic to the whole animal frame; thence we find "that the result of a medicine," as Dr. John Reid justly remarks, "depends much upon the respect which the patient feels for his physician." Faith will give a virtue to the most inefficient remedy; a distrust in the abilities of a professional adviser will often defeat the tendency of his most judicious and seasonable prescriptions.

g.—*Imagination*. The direct influence of the *Imagination* over the corporeal functions is no less obvious. The watering of the mouth, when we think on food which is agreeable, is a familiar illustration of this fact. The idea of disgust sometimes causes nausea and even vomiting. This is strikingly illustrated in the following anecdotes. "A respectable farmer in Scotland, when a young man, had sat up for a whole night with some companions, and drank ale and spirits until he became sick, and had most unpleasant sensations. For more than twenty years afterwards, he never came near, nor

passed the house, without suffering sensations similar to those which he had experienced on the night of his debauch." I know a gentleman who cannot hear the description of any surgical operation without fainting: yet, he is a man superior to affectation. 'The disease termed *Nostalgia*, or Home-sickness, a complaint to which the Swiss are peculiarly liable, is a striking instance of the power of moral causes to produce even organic diseases: for, in dissections of these cases, as we are informed by Avenbrugger, adhesions of the pleura, and appearances of inflammation having affected the lungs, are almost always observed. Very similar effects to those produced by home-sickness, are those which follow *disappointments* in love upon the female frame: the pulse becomes small and tremulous; the spirits dejected, as indicated by deep sighs; the stomach suffers; the appetite fails; cold sweats and watchfulness follow, which gradually terminate in consumption, sometimes in insanity. This is especially the case when there is a necessity for a concealment of the passion: like intense grief, it gradually undermines the constitution; hope flies the mind; the whole bodily powers fail; the menses are suppressed; and the leucophlegmatic aspect of the countenance soon points out that some secret cause preys upon the heart, disturbing all the operations both of the body and the mind.

“ She pin’d in thought,
And, with a green and yellow melancholy,
She sat like Patience on a monument,
Smiling at grief.”

In such a state, the powers of medicine are of no avail; the influence of the most active are scarcely felt upon the habit; the well-grounded expectations of the prescriber are frustrated; and the patient sinks the victim of the influence of moral causes on the bodily functions.

In regarding these effects of the influence of mind upon the functions and structure of the body, we cannot be surprised that the same agent should greatly control the operation of medicines. “Your faith has made you whole” is a phrase of Scripture, which has been properly understood as implying

a miracle, in circumstances to which it alludes : but the expression is also applicable, as I have already hinted, to daily experience, without resorting for an explanation to supernatural aid. It is this which often renders the same medicine more successful in the hands of the practitioner who has acquired popular celebrity, than in those of others perhaps more conversant with the nature and treatment of diseases. "A similar remark," says Dr. Reid, adverting to this subject, "may be made with regard to medicines themselves. A new medicine will often obtain a fortuitous fame, during the continuance of which there is no doubt that it actually produces some of those salutary effects which are ascribed to it. But the fault of these new remedies is, that they will not keep. For as soon as the caprice of the day has gone by, and Fashion has withdrawn her protecting influence, the once celebrated recipe is divested of its beneficial properties, if it do not become positively deleterious ; by which it would appear that its reputation had not been the result of its salutary efficacy, but that its salutary efficacy had been, in a great measure at least, the result of its reputation."

We acknowledge the powerful control of *Imagination* in the ordinary affairs of life ; we say that it is the source of the most refined of our pleasures : it supplies the painter and the statuary with all the subjects on which their genius is exercised ; it furnishes the poet with the materials which he combines ;—

" bodies forth
The forms of things unknown,—
Turns them to shape, and gives to airy nothing
A local habitation and a name."*

Can we then be surprised that it should influence the body in disease ; and, consequently, powerfully modify the action of medicines ? It must be remarked, however, that it is only on minds of an inferior stamp, and we find these in every rank of society, that *Imagination* exerts its powerful influence over the operation of medicines : and it is a subject

* Shakspeare.

of curious inquiry, how it happens that, in this matter, Imagination operates more upon those who are less accustomed to exercise it, than on the more intellectual, who are in the hourly habit of indulging in and cherishing its visions? To answer this query, we must admit, that the chief mental difference between these two classes of individuals is displayed in the regulation of thought, or the possession of that power which enables us to dismiss or take up certain ideas at pleasure. Now, to the class to which I have alluded as being generally most influenced by imagination, in matters relating to disease and its treatment, although the mind is usually almost wholly absorbed with common-place perceptions and ordinary occupations, yet, when the Imagination is once excited, the objects of it cannot be dismissed as they can be by a well-governed mind; they become, therefore, paramount for a period: the Imagination opens the mind of the patient to believe any thing: he arrives at a state of the most absurd credulity: nothing appears impossible to him; and his recovery from disease, the preservation of his life, even his death, depend altogether on the workings of his fancy. However well adapted a remedy may be to fulfil the indications for which it is prescribed, if the patient have no confidence in it, all that will result from its use will be disappointment; whereas his faith will render the most inert medicines powerful, and even bestow properties upon some the most opposite to those which they usually exert. This is well illustrated in an anecdote which the late Dr. James Gregory, of Edinburgh, used to relate, in his Lectures on the Practice of Medicine. A student who was labouring under fever, and was attended by Dr. Gregory, required the administration of an Anodyne to procure sleep. He was informed by the Doctor that he would order an opiate for him to be taken at bedtime. The patient, however, from not hearing well, misunderstood the term, and supposed that he was to take a purgative. Next morning, accordingly, when the Doctor visited his patient, he enquired what his anodyne had done for him?—"Anodyne," replied the astonished patient, "I understood it was a purgative, and a very active one it has proved. I have had four copious stools, and feel myself much relieved."

It is to the operation of this condition of the mind that we must attribute the few *real* cures recorded in the annals of modern Empiricism; and those well-authenticated instances of people dying at the exact time which they themselves had prognosticated. On the same principles, a physician should always cheer a timorous patient, and raise his confidence both in himself and in the medicine which he prescribes; for even in such a state of mind the very look of a physician, whose opinion the patient has been accustomed to regard with reverence, if it bespeak danger, almost pronounces the sentence; and too often it unhappily executes itself.

“ We are not ourselves,
When nature, being opprest, commands the mind
To suffer with the body.”*

h.—Credulity. In medicine, this is not a modern folly: thirteen hundred years have elapsed since Ætius described and ridiculed the nostrums of his time, and the extravagant sums paid for them. The Collyrium of Danaus was sold at Constantinople for one hundred and twenty numismata, equal to nine pounds sterling, according to the present value of coin. Dr. Fauceby, physician to Henry VI, pretended to be an adept in the occult sciences, and obtained a commission from that king to discover an universal medicine, called *the Elixir of life*, for the cure of all diseases, wounds, and fractures, and for prolonging life, the health and strength of the body, and the vigor of the mind, to the greatest possible extent of time. Dr. Henry, the historian, who quotes this passage from Rymer's *Fœdera*, adds, with great simplicity,—“ We have no account of the success of this undertaking.” Credulity, however, has sometimes cured diseases.†

Credulity differs from *Superstition*: the former may be de-

* Shakspeare.

† This was most strikingly exemplified at the time when Metallic Tractors occupied the attention and imposed upon the credulity of the public. Dr. Haygarth removed Rheumatic pains by Tractors made of wood, ivory, and even gingerbread.

fining a deficient state of the faculty of judgment, or a neglect of exercising it in particular instances ; the latter an improper application of the faculty of judgment, a conviction that the event which is to be believed is impossible, as far as human means can effect it ; but that it is nevertheless accomplished through supernatural agency. Thus, when we read that the Payes of the Indian tribes in Brazil, who are physicians, conjurors, and exorcists, cure diseases by sucking the part affected, and spitting into a pit, as if to give back to the earth the evil principle which they assert is the cause of disease and has been sucked out of the sick person, we have an example of credulity and also of superstition in those who believe them. It is *credulity* to believe that a disease can be thus extracted, as if it were a material substance : it is *superstition* to believe that disease is an evil principle, and can be conquered only through the medium of the priesthood. Superstition is more the companion of Ignorance than Credulity, although there are some men who are naturally incapable of weighing the preponderance of contrary proofs and testimonies : but, very often, Credulity arises from mere indolence of the reasoning faculty ; and a man takes what is told to him upon trust, because it is too much trouble to ascertain the probability of the proposition.* In either case, when Credulity is wrought upon by knavery, it becomes a greater obstacle to the advancement of medicine than even Superstition : but, as its influence on the operation of medicine is undoubted, it becomes a question, how far an honest physician is authorized to call into his aid, in treating any case of disease, his influence on the *Credulity* of his patient ? It is a question, certainly, of considerable delicacy ; and, if the idea were correct that a physician degrades his profession by yielding to the tide of opinion, it could only be answered in the negative : but circumstances will occur in which a physician must be guided by his own judgment of the propriety of such a step. He may see it

* Two days ago (June 27th, 1832), I heard a barrister, one of the most distinguished ornaments of the British bar, declare in open court his confidence in the remedial power of Metallic Tractors.

necessary to respect a wholesome prejudice ; and may honestly act upon his patient's credulity in order to secure his confidence in the powers of certain medicines ; or, independent of medicines, a physician, by taking advantage of the credulity of his patient, may secure his relief from the pressure of disease : for, as has been remarked by an able writer whose words I have quoted more than once, " It is of little consequence whether a man be healed through the medium of his fancy or his stomach."

Superstition.—The influence of *Superstition* over the operation of medicines is much more limited than that of Credulity ; but it operates as a powerful obstacle to the advancement of medicine in those countries where it still exists. At an early period in the history of society, Superstition supplied many articles of the *Materia Medica* ; but, as education advanced, these fell into disuse. The influence of Superstition arose from the characters of Priest and Physician being combined in the same person. This was the case with the Jews, as we learn from the Mosaical accounts of their early history. The priests of Æsculapius were also the first physicians of the Greeks. The Druids were those of the Northern nations : and, in the history of our own country, we read that, after the Anglo-Saxons had embraced the Christian religion, the clergy were the only medical practitioners. The first medical book translated into the Saxon language was the work of Apuleius on the virtues of herbs ; and on this the whole of the practice of medicine was founded until the tenth century, when the monks took up both the teaching and the practice of the healing art, and drew their information from the writings of Galen, Rhazes, Avicenna, and other Arabians, which were translated into Latin and deposited in the monasteries. In the eleventh century, the clergy applied themselves particularly to the study of *Materia Medica*. Richard Fitz-Nigel, who died Bishop of London, A.D. 1198, had been apothecary to Henry the Second : Roger Bacon, who flourished in the thirteenth century, practised physic, although a monk : in the same century, Nicolas de Farneham, physician to Henry the Third, was made Bishop of Durham : and many other doctors of

medicine were, at various times, elevated to ecclesiastical dignities. It was even thought essential that physicians should remain in a state of celibacy; and it was not until the fifteenth century that they were permitted to marry in countries professing the Roman Catholic religion. In periods like these Superstition held her sway, equally over the religious opinions and the credulity of the multitude, in matters relating to the cure of their diseases. It was easier for a crafty priesthood to work upon the weakness of the mind than to investigate the nature of diseases and their remedies: thence, we find that the same means which they had so successfully employed in duping mankind, in matters of religion, were turned to equal account in what related to medicine. Little confidence was placed in medicines, even at a later period; for Burton, in his *Anatomy of Melancholy*, informs us “that there was of old no use of physicke amongst us, and but little at this day, except it be for a few nice idle citizens, surfetting courtiers, and staufed gentlemen lubbers. The country people use kitchen physicke.”

If we go back to the period of Scripture history, we find that the Jews had great faith in phylacteries—a species of amulets, which are still held in esteem in India and other Eastern countries. They consisted of portions of Scripture written upon vellum of a shape and size adapted to the part of the body on which they were to be worn. Thus, a phylactery for the head, preserved in the Duke of Sussex’s library, consists of four slips of vellum, with verses from Scripture written on each. These are separately rolled up, and placed in a small leathern bag, upon which is written the word *schin*. It is tied to the head by means of thongs of leather, so as to permit the bag to rest on the forehead. These phylacteries are called *tephillin*, *shel-rash*, *tiffila* of the head. Those for the arm are called *sheljad*: they are written upon a strip of vellum, which is rolled up spirally to a point, and enclosed in a case made of the skin of any clean beast. They are bound upon the arm, in a situation as near to the heart as possible, by a thong which must go seven times round the arm in a spiral manner and terminate by being wound three times round the middle finger. Coral, worn round the

neck, was supposed to possess the power of driving away evil spirits*.

As Christianity advanced, the Clerical physicians seemed anxious to render the dogmas of the existing religion subservient to medicine; and, consequently, relics were introduced into the *Materia Medica*. We read that bread, dipped in oil at the shrine of St. Anthony, at Rome, was believed to prevent Hydrophobia in those bitten by a rabid animal; that a ring, taken from the body of St. Remigius, and dipped in water, produced a drink very efficacious in fevers; and the following cure for Epilepsy in children is recommended by John of Gaddesden, Walter Gilbert, and others, who flourished in the thirteenth century. "When the patient and his parents have fasted three days, let them conduct him to the church. If he be of a proper age, and in his right senses, let him confess. Then let him hear mass on Friday, during the fast of *quatuor temporum*, and also on Saturday. On Sunday, let a good and religious priest read, over the head of the patient, in the church, the gospel which is read in September, in the time of vintage, after the feast of the holy cross. After this, let the priest write the same gospel devoutly, and let the patient wear it about his neck, and he shall be cured. The gospel is—'This kind goeth not out but by prayer and fasting.'"

It would be a waste of time to enumerate many more of these absurdities: I shall notice one more only, because it descended almost to our own times; I refer to the royal touch for the cure of Scrophula. This superstition took its rise in the reign of Edward the Confessor; and nothing can demonstrate, more clearly, the powerful influence of mind over the body than the effects which followed when it was employed. In 1349 Bishop Bradwardine wrote respecting it, in these strong terms: "Whoever thou art, O Christian! who deniest miracles, come and see with thine own eyes, come into England into the presence of the king, and bring with thee any

* It is melancholy to think that a relic of this superstition is still countenanced by the higher ranks in this country: beads formed of the root of the Bryony are strung together, and sold under the name of anodyne necklaces for facilitating the protrusion of the teeth in the gums of an infant.

Christian afflicted with the King's Evil; and though it be very ugly, deep, and inveterate, he will cure him in the name of Jesus Christ, by prayer, benediction, the sign of the cross, and the imposition of hands*."

Queen Elizabeth exercised the touch for the King's Evil, and Shakspeare, probably having witnessed this ceremony, notices it in the 'Tragedy of Macbeth.

Mal. Comes the King forth, I pray you?

Doct. Ay, Sir; there are a crew of wretched souls
That stay his cure; their malady convinces
The great assay of art. But at his touch,
Such sanctity hath heav'n given his hand,
They presently amend.

Mal. I thank you, Doctor.

Macd. What's the disease he means?

Mal. 'Tis called the Evil,
A most miraculous work in this good King,
Which often since my here-remain in *England*
I've seen him do. How he solicits heav'n
Himself best knows; but strangely-visited people,
All swol'n and ulc'rous, pitiful to the eye,
The mere despair of surgery, he cures;
Hanging a golden stamp about their necks,
Put on with holy prayers: and 'tis spoken,
To the succeeding royalty he leaves
The healing benediction.

Laneham, in his "Account of the Entertainment at Kenilworth Castle," avers that he saw Queen Elizabeth cure nine persons "without other medicines than by touching and prayer." Even the great Bacon believed in the power of charming away warts. The doctrine of *sympathetic* indications and cures, indeed, would fill volumes; and although many of them are to be referred to *idiosyncrasy*, yet not a few are altogether the work of *credulity*.

But the influence of credulity and superstition could not continue; and, although credulity still sways, in some degree, the multitude, and quackery flourishes, yet education has already opened the eyes of the ignorant and expelled the mummeries of *superstition*. It must, however, be admitted

* Bradwardine de Causa Dei, l. x, ch. x, p. 39.

that even the most absurd means of cure adopted by superstition were sometimes beneficial—a circumstance which we must attribute to the confidence they inspired acting as a powerful tonic on the corporeal frame.

Upon the whole, there can be no doubt that imagination, credulity, and superstition, influence powerfully the operation of medicinal agents; and that their effects ought to be familiar to the physician. In knowing the extent of their influence, he is enabled to determine the real value of a medicine; how much is due to the workings of credulity, or superstition; and how much to the impression which the previous character of the medicine has made upon the mind.

INFLUENCE WHICH THE PERIOD OF A DISEASE EXERTS OVER THE ACTION OF MEDICINES.

It is easy to conceive that many circumstances connected with the progress of disease (the changes, for example, in the nervous irritability, in the force of the circulation of the blood, and in the temperature of the body) must tend to render the administration of a medicine which acts beneficially at one time less beneficial at another. A few examples will illustrate the truth of this position. If a drastic purgative be given soon after an ague has been checked by tonics, it is probable that the disease will return—a remark which was noticed by Sydenham and De Haen, both high authorities in all practical matters. Thus, also, at the commencement of *dysentery*, whilst inflammation of the mucous membrane exists in the large intestines, it would be extremely hazardous to administer stimulants, tonics, and astringents; but, when the inflammatory symptoms have abated, when the debility which is the result of that state alone threatens the life of the patient, then tonics and astringents are not only admissible, but they are absolutely required. In some diseased conditions of the habit, a common purgative may prove even fatal, if administered at an improper time, independent of that state of great corporeal debility, which would prevent any sensible practitioner from

prescribing a medicine the operation of which would only add to the already too greatly exhausted state of the body. Thus, when accumulations take place in the bowels, from mechanical causes, such as hernia, intusception, or permanent contractions, fatal results have followed the administration of a violent cathartic: and equally dangerous might prove the administration of cathartics whilst the intestines are in a highly irritable state, either from inflammation, ulceration, or an inordinate determination of blood to them from any cause.

The influence of the period of disease, in controlling the operation of medicines, might be illustrated by many other examples, were it not premature to bring them forward at the present moment. I will merely, therefore, mention one or two more in support of my position. In dropsy, if Foxglove be given early, whilst the pulse is hard, quick, and incompressible, it produces no beneficial effects, the functions of the capillaries are not increased, nor is the secretion of urine augmented; but, if the excitement be first reduced, whether by bleeding or any other means, the remedy then fulfils the indication of its administration; it lowers the pulse, unloads the capillaries, increases greatly the secretion of the kidneys, and relieves the serous sac of the superabundant fluid which has been deposited in it. If the action of the same medicine, Foxglove, whether administered in dropsy or in phthisis, be not closely watched, the medicine appears to accumulate in the system, and dangerous results supervene; but, in other states of the habit (in insanity, for instance, accompanied with great watchfulness), the remedy may be carried to an extent far beyond that which is safe under any other circumstances. I have given an insane patient sixty minims of the Tincture of Foxglove every sixth hour, for several successive days, with no other effect than that of procuring quiet and sleep. It is necessary, however, to state that this dose was not given until the medicine had been administered for upwards of a week, in gradually augmented doses. In general it is proper to begin with ten or fifteen minims; after which the dose may be increased five minims each alternate dose until sleep be procured. When this has been ef-

fect, the dose must then be diminished in the same ratio in which it was augmented.

Many salutary processes, also, occur, in the progress of disease, which should not be checked by an improper administration of medicines. Thus, violent shiverings and tremors of the body, unaccompanied with coldness and not followed by preternatural heat, occasionally relieve acute gouty pains; but, when these are interfered with, metastasis or a translation of diseased action occurs, and the inflammation, instead of remaining in the toe or the instep, attacks the head or the stomach. In the administration of local remedies, also, much caution is requisite; and every day's experience teaches us why many local diseases cannot be removed, or even checked, by local remedies, without the hazard of converting topical into general disease, or causing what may be termed a constitutional effort in some other part more essential to life than that which the attempt was made to relieve. In the administration of some *internal* medicines, also, the result may be a check to the salutary action of some local disease on the system, and thus, for a temporary and delusive suspension of present suffering, the most serious evil may follow. Thus, the shivering which often attends the passing of a gall-stone is supposed to operate like exercise and to aid in the propulsion of the extraneous body. Even convulsions sometimes may be regarded as a salutary process. Dr. Parry mentions the case of a young lady who was long afflicted with headache, vertigo, and vomiting, which at length ended in total blindness, so as to induce a belief that she laboured under hydrocephalus internus; all the symptoms were, in a few hours, removed by a violent fit of convulsions*. I have mentioned these instances to shew that the knowledge of the powers of a remedy does not constitute all which the physician ought to possess previous to prescribing it, even supposing he has taken into account all the circumstances which have been described as likely to modify its effects: he must, also, be convinced that no danger will result from its salutary

* Elements of Pathology and Therapeutics.

influence in one part producing a translation of diseased action to another previously in a healthy state.

The nature of the symptoms of disease often greatly modifies the operation of medicines: large doses of opium may be swallowed with impunity, during violent pain or spasm, one half of which, in the ordinary condition of the habit of the patient, would prove highly injurious, if not fatal. In diseases connected with great excitement, also, opium is injurious in the commencement, although, in combination with other medicines which diminish its stimulant properties, no remedy is so efficacious after bleeding, purging, or any treatment which can bring down the hardness and lessen the frequency of the pulse. On the other hand, it is injurious in the hectic stage of pulmonary consumption, from its tendency to promote sweatings, although, in the early stages of consumption, it is highly beneficial.

In the same way, Cinchona Bark, or its active principle Quinia, although the best remedy for intermittent fevers when administered at the proper period of the disease, increases all the bad symptoms if exhibited during the hot stage of the paroxysm. In some local affections, also, symptoms closely resembling those of ague present themselves: as, for example, in stricture of the urethra, a fit of ague is induced by a debauch of wine, by the introduction of a bougie armed with caustic into the urethra, and by many other sources of irritation, yet Bark or Quinia, in such cases, generally does harm; and a saline purgative only is required to remove every symptom of ague.

Squill has been successfully employed as an expectorant and a diuretic; but its operation is much influenced by the period of the disease at which it is prescribed. If given, for instance, during the continuance of inflammatory action, it invariably proves injurious, and, therefore, either bleeding, purging, or some other means of diminishing arterial excitement, are essential, in order to secure the beneficial action of squills.

In this manner I might travel through the whole of the *Materia Medica*, and find that, whatever influence any substance possesses in allaying disease, much depends on the

period of the disease, and the circumstances under which it is administered, as well as the condition of the body at the time: but this would be anticipating the remarks on the therapeutical employment of each article of the *Materia Medica*. In truth, no substance, the mildest in its effects, can be given in improper doses or at improper times without proving hurtful; and, in this point of view, the most nutritious and wholesome articles of diet may be ranked, almost, among the class of poisons. Even in prescribing external remedies, it is of importance to attend to the period of the disease: thus, the hot bath (that is, a bath of a temperature above 98° Farenheit), if used in the stage of excitement of any disease, may induce apoplexy. In debilitated habits, the cold bath (between 42° and 85° Farenheit) should never be employed before breakfast, for no reaction follows, and apoplexy may also ensue.

PART II.

SECTION I.

NATURAL CLASSIFICATION OF MEDICINAL AGENTS.

THE substances employed as medicines are found, in common with the other objects of Nature, every where surrounding us. They are either *natural*, that is, they are found ready formed on the surface of the earth or beneath it; or they are *artificial*, that is, changed from their natural condition, either by the abstraction of some of their parts, or by the addition of new parts. The natural substances consist of both simple and compound bodies, derived from the organic and inorganic kingdoms of Nature; the artificial are the productions of the Pharmaceutical Art: thence, the study of the nature of medicinal agents implies some acquaintance with Natural History and Chemical Science.

The medicinal agents which are the products of organization are of animal and vegetable origin: the inorganic substances are minerals.

ANIMAL SUBSTANCES.

The animal products are few. As objects of Natural History, I prefer arranging them according to the Classification of Cuvier, which is now generally adopted: and as, in describing them hereafter, I shall have occasion to make frequent reference to that system, I think it necessary to present here a brief view of those parts of it in which the animals yielding medicinal products hold a place.

The VERTEBRATED ANIMALS, *Animalia Vetebrata*, which form the first great division of the Animal Kingdom,

are those in which the body and its members are supported by a skeleton or osseous frame-work, consisting of numerous pieces articulated together, moveable upon one another, and affording points for the origin and insertion of the muscles, with which this frame-work is more or less completely covered. The brain, and the principal trunk of the nervous system, the spinal marrow, are contained in a cavity, composed of various bones forming a cranium and a hollow vertebral column. The vertebrata have all red blood; a muscular heart; a more or less voluminous liver; two horizontal jaws; distinct organs of seeing, hearing, smelling, and tasting, placed in the cavities of the head: and the sexes distinct.

The first Class of this division, *Mammifera*, named from the animals being furnished with mammæ which secrete milk for the nutriment of the young, is the only class of this division that contains animals yielding Medicinal substances.

The fourth Order of this Class, *Rodentia*, is characterized by each jaw containing two strong, sharp, curved, cutting teeth, in front, with an empty space between them and the grinders on each side. The posterior extremities are, in general, longer than the anterior, which gives the animals an awkward gait. The intestinal canal is long, the stomach simple, and the cœcum very large. This order contains the Beaver, *Castor fiber*, an amphibious animal, which supplies the medicine named *Castor*.

The sixth Order of this Class, *Pachydermata*, contains animals with two or more toes on each foot, furnished at their extremities with nails closely approximating to hoofs, but which can be used for grasping. In the second division of this order we find the Hog, *Sus scrofa*, from whose flanks *Lard* is obtained.

In the eighth Order, *Ruminantia*, of the same Class, the chief characteristic, as its name implies, is the rumination of the animals—a faculty connected with the disposition of their stomachs, which are four in number. In the two first, the food is formed into small globular pellets, in which form it is returned into the mouth and remasticated before it passes into the third, and, lastly, into the fourth stomach,

which is the real digesting organ. The animals in this order have no incisors in the upper jaw: they are furnished with two hoofs, so placed in relation to each other that they resemble one cleft hoof, whence the name *cloven-footed*. They are all phytivorous animals. In the division of the order containing animals without horns, we find the Musk Deer, *Moschus moschiferus*, the animal which yields the Musk. In the second division of the same order, containing animals with horns, we find the Stag, *Cervus elaphus*, from the horns of which a nutritive gelatine is extracted.

The ninth Order, *Cetacea*, contains animals which resemble fishes: they have no hind feet, but a tail-fin, which is transverse: their head is united to the trunk of the body by a very short, scarcely distinct neck; the anterior extremities resemble fins; they have no posterior extremities: the mammæ are placed on the breast, or near the anus. The *Cetacea* breathe by lungs, which obliges them often to rise to the surface of the water. They are warm-blooded animals. In this order we find the Spermaceti Whale, *Physeter Macrocephalus*.

The ARTICULATED ANIMALS, *Animalia articulata*, the third great division in the System of Cuvier, are characterized by the successive joints or articulations which constitute their bodies; and which are, for the most part, horny or stony, although, in a few instances, soft. Their nervous system consists of two cords, united by ganglia, at certain distances, whence the nerves are given off. The Articulated animals breathe either by gills, or by lateral stigmata: and, in a few instances, by cellular cavities analagous to lungs. The organs of circulation vary considerably: in some instances a heart exists, in others not: the organs of the senses, with the exception of that of sight, are little developed.

The chief characteristic of the first Class of this division, *Annelida*, is, the body soft, and formed either of a great many rings, or segments of rings. Although the circulation is carried on both by arteries and veins, yet, there is no distinct heart. They have generally from two to three jaws; but in some instances the mouth consists of the open ex-

tremity of a simple tube. They breathe in general by gills, and live chiefly in water.

The third Order of the Annelida, the *Abranchidea*, contains animals devoid of visible respiratory organs; and here Cuvier has placed the Leech, *Hirudo officinalis*: the propriety of this situation for the Leech is questionable, as I shall endeavour hereafter to demonstrate in treating of its remedial use.

The second Class, *Crustacea*, of the Articulata, is distinguished by the articulations being hard, crustaceous, or stony. The animals have a double circulation; they breathe by gills, variously situated. The nervous system consists of numerous ganglia, disposed in pairs. There are generally four antennæ or feelers; and the eyes are sometimes sessile, sometimes elevated upon an articulated pedicle.

In the first Order of this Class, *Crustacea*, we find the Cray Fish, Cancer *astacus*.

In the fourth Class, *Insecta*, of the same Group, we find four medicinal orders. The Class is well drawn; but its characters are so various, that it is unnecessary to describe them.

The fifth Order of the Class, *Coleoptera*, is characterized by the insect having six feet and four wings, the two uppermost of which are elytra or sheaths, horny, and always parallel to one another. We find here the Blistering Beetle, *Cantharis officinalis*, and the *Mylabris variabilis*, both yielding the blistering principle, *Cantharidin*. The perfect insects are soft when they change from the chrysalis, but harden after exposure to the air.

The seventh Order, *Hemiptera*, contains insects with six legs and four wings, of which the upper are larger and stronger than the lower, and horny and firm at the root, but soft and thin at the outer extremity. The head is depressed upon the chest; and although some of the genera have jaws, yet, the greater number are furnished with a proboscis. Here we find the Cochineal insect, *Coccus Cacti*.

In the twelfth Order, *Diptera*, the insects have six legs and two wings, with winglets or poisers (halteres) attached behind them, situated on the thorax: in some, the sucking tube is

hard and pointed ; in others, it is a soft proboscis ; and in others there is a simple mouth. This order contains the Bee, *Apis mellifica*, the manufacturer of both the wax and honey employed in medicine.

In the fourth Group of Cuvier, *Zoophyta* or radiated animals, the organs of motion surround a centre ; there is no distinct nervous system ; no particular organs of the senses, and scarcely any traces of circulation.

In the fourth Order, *Polypi*, which closely resemble plants, each body consisting of an aggregate mass of animals, and reproducing by germs, we find only one medicinal agent, the Sponge, *Spongia officinalis*.

SECTION II.

VEGETABLE SUBSTANCES.

Although the Linnean or Artificial System be that which has hitherto been employed for classing medicinal plants, as objects of Botany, yet, the Natural System holds out so many advantages to Medical Science, that there can be one opinion only of its superiority in a practical point of view : it informs the medical enquirer not only of the botanical affinities of the plants, but also supplies him with a knowledge of their properties and qualities. This acquaintance with the properties of even one plant of any order enables him to form some idea of the remedial value of all the other plants in the same order, and, if needful, to substitute, upon fixed principles, any one of them for that which is more usually employed.

The great divisions of this System are *two* :

I. VASCULAR PLANTS, VASCULARES ; plants having spiral vessels, both in the stems and leaves ; cuticular stomatia* ; distinct flowers ; and sexual organs†.

II. CELLULAR PLANTS, CELLULARES ; plants devoid of spiral vessels and sexual organs.

* Stomatia—organized pores, perhaps for breathing, like the spiracula of insects.

† Sexual organs comprehend the anthers and stigma.

The first division contains, with a few exceptions, all the plants comprehended in the *Materia Medica* of the British Colleges. It is subdivided into two subclasses:

1. DICOTYLEDONOUS PLANTS, or EXOGENÆ; plants with distinct pith, wood, and bark, in the stem and its ramifications; reticulated leaves; and fruit having an embryo with two or more opposite cotyledons or seed lobes. The plants grow by new layers annually deposited on the exterior surface.

2. MONOCOTYLEDONOUS PLANTS, or ENDOGENÆ; plants with no distinction of pith, wood, and bark, in the stem; with leaves displaying parallel veins; and fruit having an embryo with one cotyledon only; or, if there be two cotyledons, they are not opposite but alternate. The increase of the stem is by internal additions.

Seven eighths of the medicinal plants in the British Pharmacopœias belong to the first of these subclasses; as will appear in the following arrangement of them under the orders.

DYCOTYLEDONS.

UMBELLIFERÆ. — Herbaceous plants, with fistular-furrowed stems, and divided or simple leaves sheathing at the base: *flowers* in umbels*: the *calyx* entire or five-toothed; *petals* 5, alternate with 5 *stamens* incurved in æstivation: *ovarium* didymoust†, with two *styles* and solitary pendulous *ovula*. The *seed-vessel* is traversed with vertical ridges; and has, in some instances, near the base, *vittæ*, or linear receptacles of oil.

Geographical position: The northern parts of the northern hemisphere.

Yielding an aromatic volatile oil:

Carum Carvi.

Pimpinella Anisum.

Fœniculum vulgare.

Daucus Carota.

Coriandrum sativum.

Anethum graveolens.

* Umbel—that form of inflorescence in which the subordinate stalks, rising on the summit of a common flower stalk, extend in rays.

† Two joined together.

an aromatic principle :

Archangelica officinalis.

Ammoniacum :

Ferula Orientalis.

a fœtid gum-resin :

Opopanax Chironium.

Ferula Persica.

Ferula Assafœtida.

Bubon Galbanum.

an acrid gum-resin :

Cuminum Cyminum.

a narcotic principle :

Conium maculatum.

RANUNCULACEÆ.—Herbaceous plants, with divided opposite or alternate leaves, having generally a dilated half-sheathing petiole : *calyx* formed of 3-6 sepals* : *petals* 5-15, distinct in one or more rows : *stamens* hypogynous†, indefinite in number : *anthers* bursting by longitudinal slits : *pistilla* numerous on a torus : *fruit*, distinct, simple carpella‡, containing albuminous seeds, without an arillus§ : and a minute embryo.

Geo. position : Europe, India.

Yielding a narcotic principle :

Aconitum paniculatum.

a purgative principle :

Helleborus niger.

Helleborus fœtidus.

an acrid principle :

Ranunculus flammula.

Ranunculus acris.

Delphinium staphisagria.

PAPAVERACEÆ.—Herbaceous plants with more or less divided, alternate leaves : *flowers* polypetalous, single, on long *peduncles* : *sepals* 2, deciduous : *petals* 4 or some multiple of 4 : *stamens* hypogynous : *ovarium* one-celled, with narrow, partial placentæ : *seeds* numerous.

* Parts of the calyx.

† Hypogynous—rising from a lower surface than the female parts.

‡ Carpellum—one of the seed vessels of a compound fruit.

§ Arillus—an expansion of the umbilical cord surrounding the seed.

Geo. position : Europe, Persia, China, Japan.

Yielding a narcotic principle :

Papaver somniferum.

a colouring matter :

Papaver Rhæas.

CRUCIFERÆ.—Herbaceous plants with alternate leaves: *flowers* polypetalous: the *sepals* 4, deciduous and cruciate, alternating with 4 cruciate *petals*: 6 *stamens* hypogynous or rising from a lower surface than the female organs—2 short, solitary, and opposite, 4 long, in pairs, opposite, generally distinct, but in some instances connate: *fruit*, a silique* or a silicule†. This is one of the most natural of the orders.

Geo. position : Temperate zones, tropics, and north frigid zone.

Yielding a volatile and pungent principle :

Nasturtium officinale.

Cardamine pratensis.

Cochlearia Armoracea.

Cochlearia officinalis.

Sinapis nigra.

Sinapis alba.

MYRISTICÆ.—Trees with alternate leaves without stipulæ, entire, stalked, and coriaceous: the *flowers* in racemes‡ or panicles§, each flower having a short cucullate bracte||. The flowers are diœcious and apetalous, with a three-lobed coriaceous *calyx* and columnar *stamens*: the *fruit* is baccate, dehiscent, and bivalved.

Geo. position : Tropics of India and America.

Yielding a stimulant and aromatic principle :

Myristica Moschata.

WINTEREÆ.—Trees or shrubs with alternate, coriaceous stipulate leaves, with transparent dots, and convolute, deciduous stipulæ. The *flowers* are hermaphrodite or unisexual, polypetalous, with hypogynous, short *stamens*, indefinite in

* Silique—a long, two-valved fruit with seed on both sutures.

† Silicule—a small silique nearly as broad as long.

‡ Racemes—individual flowers on a long axis.

§ Panicle—where subordinate stalks of a common stalk are subdivided.

|| Bracte—a floral leaf.

number; and oblong, adnate *anthers*, bursting by longitudinal slits. The *fruit* consists of numerous, distinct, simple carpella.

Geo. position: Southern temperate zone.

Yielding a stimulant and aromatic oleo-resin:

Drymis Winteri.

MONIMIEÆ.—Trees or shrubs with opposite *leaves*, devoid of stipulæ: *flowers* apetalous, unisexual, with a tubular *calyx*, covered in the interior with *stamens* indefinite in point of number: *anthers* bursting longitudinally: *ovaria* several and distinct with definite pendulous *ovules*. The *fruit* consists of one-seeded nuts, enclosed within the enlarged calyx.

Geo. position: South America.

Yielding a stimulant and diaphoretic principle:

Dorstenia Contrajerva.

LAURINEÆ.—Trees with entire, alternate leaves devoid of stipulæ: *flowers* apetalous, with a 4-6 cleft *calyx*, and definite perigynous* *stamens*, three of which are generally abortive: *anthers* adnate, 2-4 cells, which open by recurved valves: *fruit* baccate or drupaceous†, containing seeds without albumen.

Geo. position: Both hemispheres, except in Africa.

Yielding an aromatic principle:

Laurus Cinnamomum.

———— *Benzoin.*

———— *Nobilis.*

———— *Sassafras.*

a narcotic principle:

Laurus Camphora.

MENISPERMEÆ.—Flexible, twining, tough shrubs, with alternate, entire, mucronate leaves: small, polypetalous, racemose, unisexual flowers, with hypogynous *stamens*, opposite to the petals, supporting on their points adnate *anthers*. *Fruit*, a one-seeded drupe.

Geo. position: Tropics of Asia and America.

* Perigynous—stamens rising from the same plane as the female parts.

† Drupe—a nut surrounded by a fleshy matter, as in the cherry.

Yielding a bitter and tonic principle :

Menispermum palmatum (Calumba).

a narcotic principle :

Menispermum Cocculus.

MALVACEÆ.—Herbaceous plants, trees, or shrubs, with alternate, more or less divided, stipulate *leaves*, covered with stellate pubescence. The *flowers* are polypetalous, with hypogynous, monodelphous *stamens*, and one-celled anthers bursting longitudinally: *ovarium* formed of *carpella* round a placental axis distinct or concrete: *fruit* capsular or baccate containing seed with crumpled cotyledons.

Geo. position : Temperate zone and tropics.

Abounding in mucilage :

Althæa officinalis.

Malva Sylvestris.

DIPTEROCARPEÆ.—Trees with alternate leaves the veins of which run out from the midrib to the margin, and deciduous stipules: *flowers* polypetalous, with a tubular *calyx*, hypogynous *stamens*, indefinite in number, with subulate *anthers* opening near the apex: *fruit* coriaceous, surrounded by a foliaceous calyx, concrete *carpella*: an *ovarium* of several cells, and pendulous *ovules* in pairs.

Geo. position : Indian Archipelago.

Yielding Camphor :

Dryobalanops Camphora.

GUTTIFERÆ.—Trees or shrubs, occasionally parasites: *leaves* entire, opposite, without stipules: *flowers* polypetalous, with a persistent, imbricate, membranous *calyx*: hypogynous, unequal *stamens*, indefinite in number: adnate *anthers*: *carpella* concrete: an *ovarium* of several cells: *ovules* attached to central placentæ.

Geo. position : South America, Madagascar.

Yielding a gum-resin :

Stalagmitis Gambogioides.

SALICARIÆ.—Herbs with opposite, entire leaves without stipules: *flowers* polypetalous, with a tubular, short-toothed *calyx*: perigynous *stamens*: adnate *anthers*: *carpella* concrete, and a superior *ovarium* with several cells.

Geo. position : Europe, America, tropics of both hemispheres.

Yielding an astringent principle :

Lythrum Salicaria.

MYRTACEÆ.—Trees or shrubs with opposite, entire leaves, covered with semitransparent dots : *flowers* polypetalous, with a superior 4-5 cleft *calyx* : indefinite, perigynous *stamens*, with ovate *anthers* bursting lengthways : *carpella* concrete : inferior *ovarium* with several cells.

Geo. position : South America, East Indies.

Yielding an aromatic principle :

Melaleuca minor (M. Cajuputi).

Caryophyllus aromaticus.

Eugenia Pimenta.

an astringent principle :

Eucalyptus resinifera.

Punica Granatum.

ARISTOLCHIÆ.—Herbs with alternate, simple, petiolate leaves : *flowers* apetalous, with a superior, tubular, valvate *calyx* : epigynous *stamens* : many-celled *ovarium* : and indefinite ovules.

Geo. position : Europe, both Americas, India.

Yielding a stimulant principle :

Aristolochia serpentaria.

Asarum Europæum.

THYMELEÆ.—Shrubs with entire, exstipulate leaves, alternate and opposite : *flowers* apetalous, with a tubular four-cleft, coloured calyx : *ovarium* single, superior, one-celled : *fruit* indehiscent : *ovules* pendulous.

Geo. position : Europe, Cape of Good Hope, New Holland.

Yielding an acrid principle :

Daphne Mezereum.

ROSACEÆ. — Herbaceous plants and shrubs with alternate, stipulate leaves : *flowers* polypetalous, with regular, perigynous *stamens*, lateral *styles*, superior, simple *ovaries* : exalbuminous, definite seeds.

Geo. position : Temperate zone.

Yielding an astringent principle :

Geum Urbanum.

Tormentilla erecta.

Rosa Canina.

—— *centifolia.*

—— *Gallica.*

POMACEÆ.—Trees or shrubs with alternate, stipulate leaves: *flowers* polypetalous, with perigynous *stamens*, indefinite in number, adhering to the throat of the calyx: *fruit*, a one or five-celled pome*.

Geo. position: Europe, Asia, North America, India.

Demulsive:

Pyrus Cydonia.

AMYGDALÆ.—Trees with simple, alternate, stipulate leaves, glandular at the base: *flowers* polypetalous, with regular, perigynous *stamens* indefinite in number: innate, two-celled *anthers*: a superior, solitary, simple *ovarium*, with a terminal *style*: *fruit* a drupe: *seed* exalbuminous, suspended: cotyledons thick.

Geo. position: Temperate zone.

Demulsive and laxative:

Amygdalus communis.

Prunus domestica.

—— *Persica.*

Yielding a sedative principle (Hydrocyanic Acid):

Prunus Laurocerasus.

Amygdalus Amara.

LEGUMINOSÆ.—Herbs with alternate, stipulate leaves: *flowers* polypetalous, with perigynous *stamens*, monodelphous or diadelphous: *ovary* solitary, simple, superior: *style* terminal: *fruit* leguminous: *seed* exalbuminous: peritropal *ovules*.

Geo. position: Equinoctial zone and both hemispheres beyond the tropics, but chiefly the north.

Yielding a saccharine matter:

Glycyrrhiza glabra.

acids:

Tamarindus Indica.

Gum:

Acacia vera.

* Pome—a capsule surrounded by a fleshy covering.

Acacia Arabica.

Astragalus Tragacantha.

———— *verus.*

———— *Creticus.*

a purgative principle :

Cassia Senna.

———— *lanceolata.*

———— *fistula.*

Oleo-resin :

Copaifera officinalis.

Myroxylon Peruiferum.

an acrid principle :

Geoffræa enermis.

Spartium Scoparium.

a mechanical-acrid :

Dolichos pruriens.

an astringent principle :

Hæmatoxylon Campechianum.

Pterocarpus Santalinus.

———— *Draco.*

———— *Africanus.*

URTICEÆ.—Trees or shrubs with alternate, scabrous, stipulate leaves: *flowers* apetalous, solitary, or clustered: *stamens* definite, inserted into the tube of the *calyx*: *ovarium* superior, two-celled: *fruit*, a nut, indehiscent: *embryo* straight, curved, or spiral, albuminous or exalbuminous.

Geo. position : General over the globe.

Yielding a bitter principle :

Humulus Lupulus.

ULMACEÆ.—Trees and shrubs with alternate, scabrous, simple, stipulate leaves: *flowers* apetalous, solitary, or loosely clustered, with definite *stamens* inserted into the base of the *calyx*: *ovarium* superior, with suspended *ovules*: *fruit* one or two-celled, indehiscent: *seeds* pendulous, exalbuminous.

Geo. position : Europe, Asia, North America.

Yielding Ulmin :

Ulmus campestris.

ARTOCARPEÆ.—Trees, shrubs, or herbs, with alternate stipulate leaves covered with asperities: *flowers* apetalous, in

fleshy heads or catkins: *fruit*, a fleshy receptacle: *seed* suspended, solitary, with the *embryo* inverted, and its radicle pointing to the hilum.

Geo. position: Tropical climates.

Demulsive:

Ficus Carica.

Morus nigra.

CUPULIFERÆ.—Trees or shrubs with simple, alternate, stipulate leaves, with straight veins from midrib to margin: *flowers* amentaceous, dioceous, apetalous: *ovarium* inferior, enclosed in a capsule, or coriaceous involucre: *ovules* definite, pendulous, two or more in a cell: *fruit*, a horny or coriaceous nut.

Geo. position: Temperate zones.

Yielding astringent principles:

Quercus Robur.

—— *Infectoria.*

—— *pedunculata.*

SALICINÆ.—Trees or shrubs with simple, alternate, stipulate, frequently glandular leaves: *flowers* Achlamydeous*, amentaceous: *ovarium* superior, one or two celled: *fruit* coriaceous: *seeds* indefinite, comose†.

Geo. position: Europe, Northern Asia, North America.

Yielding Tannin and a tonic principle:

Salix fragilis.

—— *Alba.*

—— *Caprea.*

Populus tremula.

EUPHORBIACÆ.—Trees, shrubs, and herbaceous plants, with alternate, simple leaves: *flowers* apetalous, unisexual, axillary, or terminal: *ovarium* three-celled, with definite, suspended *ovules*: *seed* suspended, with an arillus: *embryo* surrounded with oily albumen.

Geo. position: Equinoctial America and Africa, Cape of Good Hope, a few in Europe and North America.

* Flowers in which the *calyx* and *corolla* are absent.

† Comose—having appendages consisting of long hairs.

Yielding an acrid principle :

Euphorbia officinarum.

————— *Canariensis.*

purgative acrid oil :

Croton Tiglium.

Ricinus communis.

aromatic tonic principles :

Croton Cascarilla (Eluteria ?).

nutritive fecula :

Iatropa Manihot.

RHAMNEÆ.—Trees or shrubs with simple alternate leaves with minute stipules: *flowers* axillary or terminal, polypetalous; *cucullate** *petals*; *valvate calyx*; *perigynous stamens*, definite in number: *ovarium* superior, with several cells surrounded by a fleshy disk: *seeds* erect, albuminous.

Geo. position : General over the globe, except in the Arctic zone.

Yielding a purgative principle :

Rhamnus catharticus.

VITES.—Climbing shrubs with tumid joints and stipulate leaves: *flowers* polypetalous, small, green, symmetrical, on *ramose peduncles*: *stamens* hypogynous, definite in number, with distinct filaments, and *ovate, versatile anthers*: *ovarium* entire, two-celled: *fruit* baccate: *seeds* albuminous, with an erect embryo.

Geo position : Warm and temperate zones of both hemispheres.

Yielding a saccharine matter—acid :

Vitis vinifera.

MELIACEÆ.—Trees or shrubs with alternate, exstipulate leaves: *flowers* symmetrical: *calyx* imbricated; *corolla* polypetalous; *petals* cohering at the base: *stamens* hypogynous, definite in number, combined in a long tube; *anthers* sessile within the orifice of the tube: *ovarium* of several cells, with a placental axis: *seeds* definite, apterous, exalbuminous, with a straight embryo.

Geo. position : East and West Indies, South America, Africa.

* Cucullate—surface of the petal deeply depressed.

Yielding an aromatic principle :

Canella alba.

an astringent and tonic principle :

Swietenia Mahagoni.

————— *febrifuga.*

AURANTIACEÆ.—Trees or shrubs with alternate, often compound, sometimes winged leaves, dotted: *flowers* symmetrical, polypetalous, with an urciolate *calyx*, and *petals* inserted on the outside of a hypogynous disk: *stamens* hypogynous, definite: *style* single: *ovarium* entire, many-celled: *fruit* pulpy, covered with a leathery rind, studded with receptacles of volatile oil; *seeds* attached to the *axis*, with a *raphe** and *chalaza*† distinctly marked, often containing two embryos.

Geo. position : East Indies, extended over the rest of the tropics.

Yielding an aromatic oil—acid :

Citrus aurantium.

————— *medica.*

AMYRIDEÆ.—Trees, abounding in resin, with opposite, compound, exstipulate, dotted *leaves*: *flowers* polypetalous, with small, regular *calyx* and hypogynous *petals*: definite, hypogynous *stamens*, double the number of the *petals*: *anthers* bursting by longitudinal slits: *fruit* indehiscent, subdrupaceous, one-seeded, glandular: *pericarp* covered with granular glands filled with aromatic oil.

Geo. position : India and America.

Oleo-resin :

Amyris elemifera.

————— *Gileadensis.*

DIOSMEÆ.—Trees and shrubs with exstipulate, dotted leaves: *flowers* axillary or terminal, polypetalous, symmetrical, hermaphrodite: *stamens* hypogynous, with an imbricate *calyx*, definite in number: *ovarium* sessile, entire, containing several cells: *ovules* twin: *style* single: *fruit* consisting of se-

* *Raphe*—the surface by which the two parts of a double fruit touch each other.

† *Chalaza*—coloured part in the interior membrane of the seed, where the umbilical cord passes into the seed.

veral concrete capsules: the *endocarp** separating from the *sarcocarp*†, which is two-valved: *seeds* twin or solitary, with a testaceous integument.

Geo. position: Cape of Good Hope; equinoctial regions of America.

Yielding an aromatic principle:

Diosma crenata.

Cusparia febrifuga.

RUTACEÆ.—Herbaceous plants with alternate, simple, deeply-lobed, exstipulate, dotted leaves: *flowers* symmetrical, in a centrifugal inflorescence: *calyx* 4-5 cleft, imbricate; *petals* alternate with the divisions of the calyx: definite hypogynous *stamens*: *ovarium* entire, celled: *carpella* concrete: *fruit* capsular, the *endocarp* not separable from the *sarcocarp*.

Geo. position: Temperate zones.

Yielding stimulant oil:

Ruta graveolens.

ZYGOPHYLLÆ.—Trees, shrubs, and herbaceous plants with opposite, stipulate leaves without dots: *flowers* polypetalous, symmetrical: *stamens* definite, hypogynous, dilated at the base: *ovarium* entire, with several cells: *stigma* simple: *fruit* capsular, *carpella* concrete, *ovules* pendulous.

Geo. position: America.

Yielding Guaiacum:

Guaiacum officinale.

SIMARUBACEÆ.—Trees or shrubs with alternate exstipulate leaves without dots: *flowers* polypetalous, symmetrical, with a 4-5 divided *calyx*, and *petals* equal in number to these divisions: *stamens* double the number of the petals, hypogynous: *ovarium* entire, cellular; *ovules* solitary, pendulous: *fruit* indehiscent drupes, arranged round a common receptacle: *seeds* pendulous, with an exalbuminous embryo.

Geo. position: Tropical America, Africa, India.

Yielding a bitter-tonic principle:

Quassia excelsa.

——— *simaruba*.

* Endocarp—the internal skin of the fruit.

† Sarcocarp—fleshy matter under the skin of the fruit.

POLYGALEÆ.—Shrubs or herbaceous plants with exstipulate leaves: *flowers* polypetalous, unsymmetrical: *calyx* regular, imbricated: *petals* three, one being anterior and larger than the rest: *keel* sometimes entire and crested, sometimes lobed and not crested: *stamens* definite, hypogynous in one parcel: *ovarium* superior, two-celled, with a placental *axis*: *fruit* dehiscent, with pendulous *seeds*.

Geo. position: Asia and America.

Yielding a bitter, acrid principle:

Polygala Senega.

an astringent matter:

Krameria triandra.

VIOLACEÆ.—Herbs with simple stipulate leaves: *flowers* polypetalous: *calyx* five distinct sepals: *petals* same number, hypogynous: *stamens* alternate with the *petals*, hypogynous, definite, bearing cohering, bilocular *anthers* bursting inwards: *ovarium* one-celled, many-seeded, with narrow, parietal placentæ: *seeds* with a straight *embryo*, erect in the *axis* of fleshy albumen.

Geo. position: Europe, America, Siberia.

Yielding a stimulant-emetic principle:

Viola odorata.

LINEÆ.—Herbaceous plants with entire, exstipulate, usually alternate leaves: *flowers* symmetrical, polypetalous, consisting of a regular imbricate *calyx* and unguiculate *petals*: definite, hypogynous *stamens*: an entire *ovarium* of several cells, with placentæ in the *axis*, pendulous *ovules*, a distinct *style*, and capitate *stigmas*: *seeds* compressed and inverted: exalbuminous, flat *cotyledons*.

Geo. position: Europe and North America.

Yielding Mucilage and fixed oil.

Linum ussitatissimum.

a cathartic principle:

Linum catharticum.

CARYOPHYLLÆÆ.—Herbaceous plants with opposite, entire leaves: *flowers* polypetalous, symmetrical: *calyx* imbricate: *corolla* hypogynous: *stamens* definite: *ovarium* celled, with a placental *axis*: *embryo* coiled round a mealy albumen.

Geo. position: Temperate zone.

Yielding a volatile oil.

Dianthus Caryophyllus.

POLYGONEÆ.—Herbaceous plants, with alternate stipulate, or ochreate leaves : *flowers*, in many instances, in racemes, apetalous : *stamens* definite, inserted at the bottom of the *calyx*, which is inferior and divided : *ovarium* superior, with a single, erect *ovule* : *seeds* with farinaceous albumen.

Geo. position : General over the globe.

Yielding a purgative principle :

Rheum palmatum.

—— *undulatum.*

—— *Australe.*

Rumex Aquaticus.

—— *obtusifolius.*

Acid :

Rumex acetosa.

an astringent principle :

Polygonum bistorta.

PIPERACEÆ.—Shrubs or herbaceous plants with opposite, verticillate, exstipulate leaves : *flowers* achlamydeous, with *stamens* adhering to the base of the *ovarium*, which is superior, one-celled, crowned with a sessile *stigma* : *fruit* superior, fleshy, indehiscent, one-celled : *seed* erect : *embryo* enclosed in a sac.

Geo. position : Indian Archipelago.

Yielding a stimulant-tonic principle :

Piper nigrum.

—— *longum.*

—— *Cubeba.*

STRYACEÆ.—Trees or shrubs, with alternate, exstipulate, toothed leaves : *flowers* axillary, solitary or clustered, monopetalous : *stamens* indefinite or definite, of unequal length, arising from the tube of the *corolla*, cohering slightly : *ovarium* superior, adhering to the *calyx*, containing several *cells*, definite *ovula* : *style* simple : *stigma* capitate : *fruit* drupaceous.

Geo. position : Asia, North and South America.

Yielding Resin :

Styrax officinale.

an acid and volatile oil :

Styrax Benzoin.

ERICACEÆ.—Shrubs, with evergreen, rigid, entire, whorled, exstipulate leaves: *flowers* monopetalous, regular: *calyx* persistent, inferior, 4-5 cleft: *corolla* hypogynous: *stamens* definite, inserted into the base of the *corolla*: two-celled, dry *anthers*, with appendages: *ovarium* superior, many-seeded: *seeds* apterous, with the *embryo* in the *axis* of the albumen.

Geo. position: Europe, America, Cape of Good Hope.

Yielding an astringent principle :

Arbutus uva-ursi.

a stimulant principle :

Rhododendron Chrysanthum.

PYROLACEÆ.—Herbaceous plants with simple, entire, toothed leaves: *flowers* in terminal racemes, monopetalous, regular deciduous: *stamens* hypogynous, double the number of the *petals*, bearing two-celled dry *anthers*, with appendages: *ovarium* superior, many-seeded, with a single declinate *style*: *seeds* winged: *embryo* minute, invested in fleshy albumen.

Geo. position: Europe, North America, Northern Asia.

Yielding a diuretic stimulant principle :

Pyrola Umbellata.

CUCURBITACEÆ.—Climbing herbs with palmated, succulent, scabrous leaves: *flowers* unisexual, monopetalous, with a five-toothed *calyx*, and five-parted, regular, cellular *corolla*: *stamens* cohering in three parcels: *anthers* long, sinuous: *ovarium* inferior, with three parietal placentæ: *fruit* fleshy: *seeds* flat: *testa* coriaceous: *embryo* exalbuminous.

Geo. position: 'Tropical climates: a few in the north of Europe, North America, and the Cape of Good Hope.

Yielding a purgative gum-resin :

Cucumis Colocynthis.

Elatin :

Momordica Elaterium.

VALERIANÆ.—Herbs with opposite, exstipulate leaves : *flowers* corymbose*, paniced, or in heads, monopetalous : *corolla* tubular, some calcarate† at the base : *stamens* distinct : *ovarium* inferior, two-celled : *ovules* solitary, pendulous : *fruit* dry, indehiscent : *seeds* exalbuminous.

Geo. position : Temperate zones, but uncommon in Africa and North America.

Yielding a stimulant, fœtid oil :

Valeriana officinalis.

COMPOSITÆ.—Herbaceous plants or shrubs with alternate or opposite, exstipulate leaves : *flowers* consisting of a dense head of florets on a common receptacle, enclosed by an involucre : *florets* monopetalous : *calyx* adhering to the ovary : *corolla* either funnel-shaped or ligulate : *stamens* syngenesious‡ : *anthers* cohering and opening inwards : *ovarium* one-celled, with one erect *ovule* : *fruit* a dry indehiscent pericarp, crowned with the limb of the *calyx*.

Geo. position : General over the globe.

Yielding a demulsive fecula or mucilage :

Arctium lappa.

Tussilago farfara.

a bitter principle :

Corymbiferae :

Anthemis nobilis.

Artemisia Absinthium.

———— *Chinensis.*

———— *Indica.*

———— *Santonica.*

Inula Helenium.

Chichoraceæ :

Leontodon Taraxacum,

Cynarocephalæ :

Cnicus benedictus,

* Corymbose—when the flower-stalks rising from one common stalk are of such lengths that all the flowers appear on the same horizontal plane.

† Calcarate—having a spur.

‡ Syngenesious—filaments of the *stamens* free, bearing anthers united in a tube.

a narcotic principle :

Lactuca virosa.

———— *sativa.*

an acrid principle :

Anthemis pyrethrum.

STELLATÆ.—Herbaceous plants with whorled, exstipulate scabrous leaves, and quadrilateral stems : *flowers* small, monopetalous : *corolla* rotate or tubular inserted into the *calyx* which is lobed : *stamens* definite, alternating with the segments of the *corolla* : *ovarium* two-celled : *ovules* solitary : *fruit* inferior, didymous : *seeds* erect.

Geo. position : Northern parts of the northern hemisphere.

Yielding a colouring, stimulant principle :

Rubia tinctorum.

CINCHONACEÆ.—Trees or shrubs with opposite, simple leaves, and interpetiolar *stipules* : *flowers* in panicles : *calyx* superior, simple, with connate bractes at its base : *corolla* tubular, regular, with definite divisions of the limb : *stamens* adhering to the corolla on the same line : *ovarium* inferior, crowned with a disk ; *ovules* numerous ; *style* single, with a sometimes divided *stigma* : *fruit* inferior, either splitting into two cocci* or indehiscent : *seeds* attached to central *axis* when indefinite, when definite erect : *embryo* small, albuminous.

Geo. position : Within the tropics, especially in South America.

Yielding a tonic principles :

Cinchona cordifolia.

———— *lancifolia.*

———— *Condaminea.*

———— *lanceolata.*

———— *nitida.*

———— *ovata.*

———— *oblongifolia.*

Portlandia hexandra.

* Coccum—a peculiar kind of seed vessels which opens with an elastic spring.

Yielding emetic principles :

Cephaelis Ipecacuanha.

astringent matter :

Nauclea Gamber.

CAPRIFOLIACEÆ.—Shrubs or herbaceous plants with opposite, exstipulate leaves : *flowers* corymbose, monopetalous, with a superior bracteated *calyx*, and a rotate or a tubular *corolla* : *stamens* alternating with the lobes of the corolla : *ovarium* inferior, many-celled : *ovules* pendulous : *fruit* indehiscent : *seeds* solitary and pendulous, or numerous and attached to the *axis*.

Geo. position : Northern Europe, Asia, and America.

Yielding a laxative principle :

Sambucus nigra.

a tonic principle :

Cornus florida.

ASCLEPIADEÆ.—Shrubs with entire, opposite, sometimes alternate leaves : *flowers* regular, in umbels, racemes, or fascicles : *calyx* persistent : *corolla* monopetalous, hypogynous, regular, deciduous : *stamens* five, alternate with the segments of the limb : two-celled *anthers* : *pollen* cohering in masses : *ovaria* two : *styles* two : *follicles* two.

Geo. position : Africa, India, New Holland, eastern side of North America.

Yielding an acrid principle :

Asclepias gigantia.

GENTIANEÆ.—Herbaceous plants with opposite, entire, sessile, exstipulate leaves : *flowers* terminal, axillary : *calyx* monophyllous, persistent : *corolla* hypogynous, imbricate, withering, monopetalous : *stamens* inserted into the corolla, some abortive : *ovarium* single, superior, celled : *style* continuous : *stigma* simple or bifid : *fruit* a many-seeded berry.

Geo. position : General over the globe.

Yielding bitter tonic principles :

Chironia Centaurium.

Gentiana Lutea.

Menyanthis trifoliata.

a cathartic, narcotic principle :

Spigelia Marilandica.

CONVOLVULACEÆ.—Herbaceous plants with alternate, undivided, exstipulate leaves: *flowers* axillary, or terminal, monopetalous, regular: *calyx* persistent: *corolla* hypogynous, deciduous, plaited: *stamens* inserted into the base of the corolla: *ovarium* simple, superior, 2-4-celled: *ovules* definite and erect: *style* divided: *stigma*s obtuse or acute: *seeds* albuminous.

Geo. position: Tropical climates, rare in cold climates.

Yielding a resinous, purgative principle:

Convolvulus *Scammonia*.

————— *Jalapa*.

SCROPHULARINEÆ.—Herbaceous plants with opposite leaves: *flowers* monopetalous, irregular, unsymmetrical: *calyx* divided, persistent: *corolla* hypogynous: *stamens* didymous: *ovarium* superior, two-celled: *fruit* capsular, superior, two-celled: *seed* albuminous: *embryo* in a fleshy albumen: radicle orthotropous.*

Geo. position: General over the globe.

Yielding a stimulant principle:

Gratiola *officinalis*.

Scrophularia *nodosa*.

a narcotic principle:

Digitalis *purpurea*.

OLEACEÆ.—Trees or shrubs with opposite, simple, or pinnated leaves: *flowers* regular, monopetalous, hermaphrodite, or diœcious: *calyx* monophyllous, inferior, persistent: *corolla* hypogynous, 4-cleft, valvate, sometimes apetalous: *stamens* two: *ovarium* simple, superior, two-celled: *seeds* pendulous.

Geo. position: Temperate zones.

Yielding a fixed oil:

Olea *Europea*.

manna:

Fraxinus *ornus*.

SOLANEÆ.—Herbaceous plants or shrubs, with alternate leaves: *flowers* monopetalous, regular: *calyx* inferior, five-

* Orthotropous—when a straight embryo lies in a direction the opposite to that of the grain.

parted persistent: *corolla* monopetalous, plaited, hypogynous, deciduous: *stamens* inserted into the corolla: *anthers* bursting longitudinally, and by pores at the apex: *ovarium* two-celled with two polyspermous placentæ: *ovules* indefinite: *stigma* simple: *fruit* succulent: *seeds* numerous, sessile: *embryo* curved, lying in fleshy albumen.

Geo. position: General, but especially within the tropics.

Yielding narcotic principles:

Atropa Belladonna.

Datura Stramonium.

Hyosciamus niger.

Nicotiana Tabacum.

Solanum Dulcamara.

acrid principle:

Capsicum annuum.

Demulcent mucilage:

Verbascum thapsus.

LABIATÆ.—Herbaceous plants with quadrilateral stems and opposite, exstipulate leaves: *flowers* irregular, unsymmetrical, in opposite, nearly sessile, axillary cymes: *calyx* inferior, persistent: *corolla* monopetalous, hypogynous, bilabiate: *stamens* four, didymous, inserted in the corolla: *anthers* celled: *ovarium* deeply four-lobed: *style* proceeding from the base of the lobes of the ovarium: *fruit* 1-4 small nuts in the persistent calyx: *seeds* erect.

Geo. position: Temperate zones, between parallels of 40° and 50° north latitude.

Yielding volatile oil:

Hyssopus officinalis.

Lavandula spica.

Marrubium vulgare.

Melissa officinalis.

Mentha piperita.

—— *viridis.*

—— *pulegium.*

Origanum vulgare.

—— *majorana.*

Rosmarinus officinalis.

Salvia officinalis.

BORAGINÆÆ.—Herbaceous plants or shrubs, with alternate leaves covered with asperities: *calyx* persistent, with 4-5 divisions: *corolla* monopetalous, hypogynous, regular: *stamens* inserted within the petal: *ovarium* superior, deeply lobed: *style* simple: *seeds* destitute of albumen.

Geo. position: Temperate zone of the northern hemisphere.

Yielding mucilaginous colouring matter:

Anchusa tinctoria.

CONIFERÆÆ.—Trees or shrubs with a stem abounding with resin: linear, acerose, or lanceolate leaves, entire at the margin, or dilated and lobed, sometimes fascicled: *flowers* monœcious or diœcious: *anthers* 2-lobed: *pollen* large, usually compound: *ovarium*, in the cones spread open, resembling a scale destitute of style or stigma, and arising from a membranous bracte; in the solitary flower defective: *fruit* consisting of either a solitary naked seed or of a cone: *seeds* with a hard crustaceous tegument: *embryo* in an oily albumen, with two or many opposite cotyledons.

Geo. position: Temperate climates, the Arctic circle, and the hottest regions of the Indian Archipelago.

Yielding resinous and volatile oil:

Pinus abies.

—— *sylvestris.*

—— *Larix.*

—— *Balsamea.*

Juniperus communis.

———— *Sabina*

———— *Lycia.*

MONOCOTYLEDONS.

IRIDEÆÆ.—Smooth herbaceous plants with equitant leaves: *inflorescence* terminal, in spikes, corymbs, panicles, or crowded: *flowers* hexapetalous, triandrous: *stamens* three, arising from the base of the sepals: *filaments* distinct or connate: *anthers* fixed by their base, two-celled, bursting

externally lengthways : *ovarium* three-celled, many-seeded : one *style*: five *stigmas*, often petaloid, sometimes two-lipped : *capsule* three-celled, three-valved : *seeds* attached, either to a central column or parietal placentæ : *embryos* enclosed in albumen.

Geo. position : Cape of Good Hope, middle parts of North America, Europe ; few within the tropics.

Yielding a volatile oil :

Crocus sativus.

Iris Florentina.

SCITAMINEÆ.—Herbaceous plants with a creeping, often jointed *rhizoma** and a stem formed of bases of the leaves, never branching : *leaves* simple, sheathing, having a single mid-rib, whence numerous veins diverge at an acute angle : *flowers* tripetaloideous : *calyx* superior, tubular, three-lobed : *corolla* tubular, irregular : *stamens* three, distinct, two abortive, the intermediate one fertile : *filament* not petaloid : *anther* two-celled, its lobes often embracing the upper part of the style : *pollen* globose, smooth : *ovarium* three-celled : *ovule* attached to a placental axis : *style* filiform : *stigma* dilated, hollow : *fruit* capsular, three-celled, many-seeded : *seeds* roundish or angular, with or without an arillus.

Geo. position : Tropical climates.

Yielding an aromatic, volatile, oily principle :

Zingiber officinale.

Elettaria Cardamomum.

Amomum aromaticum.

———— *maximum*.

Curcuma longa.

MELANTHACEÆ. — Herbs with a *rhizoma* sometimes fleshy, and leaves sheathing at the base, with parallel veins : *flowers* hexapetaloideous, tubular : *stamens* 6, with *anthers* turned outwards : *ovarium* three-celled : *style* trifid : *stigma* undivided : *seeds* albuminous, with a membranous *testa*.

Geo. position : Europe, Cape of Good Hope, Asia, America, New Holland.

* *Rhizoma*—a part of the stem which is sometimes underneath the soil, and always emits radicles.

Yielding veratria :

Colchicum autumnale.

Veratrum album.

ASPHODELEÆ.—Herbaceous plants, occasionally trees, with bulbs or fascicled roots: *flowers* hexapetaloideous, the *perianth* regular: *stamens* 6, hypogynous, the 3 opposite to the sepals irregular, sometimes absent: *anthers* turned inwards: *ovarium* superior, three-celled: *style* 1: *stigma* entire: *fruit* a three-celled capsule: *seeds* numerous, with a hard, black, brittle testa: *albumen* fleshy: *embryo* included.

Geo. position : Temperate climates, widely scattered.

Yielding scillitina :

Scilla maritima.

an acrid principle :

Allium sativum.

—— *Cepa.*

—— *Porrum.*

a bitter purgative principle :

Aloës Spiccata.

—— *vulgaris.*

—— *perfoliata.*

SMILACEÆ.—Herbaceous, climbing plants: *flowers* hexapetaloideous, hermaphrodite, sometimes diœcious: *perianth* inferior: *stamens* 6, inserted into the perianth: *ovarium* three-celled: *style* usually trifid: *stigmas* three: *fruit* a berry, containing seeds with a membranous testa: *albumen* nearly cartilaginous.

Geo. position : Asia, North America.

Yielding a mucilaginous, unknown principle :

Smilax Sarsaparilla.

—— *China.*

PALMÆ.—Plants with an arborescent trunk, covered with the sheathing bases of leaves: the *leaves* terminal, clustered, pinnate, or flabelliform: *inflorescence* a terminal spadix*, enclosed in a many-valved spathe†: *flowers* small, bracteolated,

* Spadix—a spike with a succulent axis, bearing either small blossoms or naked sexual organs.

† Spatha—a foliaceous floral covering, formed of one or more floral leaves.

each a hexapetaloideous, persistent *perianth*: *stamens* inserted into the base of the perianth, definite in number: *ovarium* superior, three-celled: *ovules* erect: *fruit* baccate, or drupaceous, with fibrous flesh.

Geo. position: Tropical regions, except in South America and the West Coast of New Holland.

Abounding in oil and amylaceous matter:

Cocos butyracea.

Sagus farinifera.

Phoenix farinifera.

in wax:

Ceroxylon andicola.

AROIDÆ.—Herbaceous plants with leaves sheathing at the base: *flowers* unisexual, spadiceous, enclosed in a spathe, frequently naked: *stamens* definite or indefinite, hypogynous, very short: *anthers* celled, ovate, turned outwards: *ovarium* superior, celled: *ovules* erect or pendulous: *stigma* sessile: *fruit* succulent, indehiscent: *seeds* solitary or several: *embryo* in the axis of fleshy albumen.

Geo. position: Tropical countries, where they are often arborescent: a few extend to the North of Europe, but they are herbaceous plants.

Yielding an aromatic oil:

Acorus Calamus.

GRAMINEÆ.—Herbaceous plants consisting of cylindrical fistular, siliceous, and pointed culms, with a fibrous or bulbous rhizoma, and alternate leaves with a split sheath: *flowers* in locustæ*, hermaphrodite, sometimes monœcious, glumaceous: *glumes*† alternate, unequal: *paleæ*‡ alternate, the exterior simple: *scales* 2-3, sometimes absent: *stamens* hypogynous: *anthers* versatile: *ovarium* simple: *styles* 2: *stigmas* feathery or hairy: *pericarp* membranous: *albumen* farinaceous.

Geo. position: General over the globe, a few confined to the tropics.

Yielding saccharine matter:

Saccharum officinarum.

* Locustæ—a short axis bearing alternate imbricate flowers.

† Glume—the exterior floral covering in grasses.

‡ Paleæ—small scales intermixed with the florets in the grasses.

farinaceous matter :

Avena sativa.

Hordeum distichon.

Triticum hybernum.

Secale cereale.

CELLULARES.

The second of the great divisions of the Natural System contains very few medicinal plants; but the parasites, which cover many of the medicinal barks, and are characteristic of their qualities, belong to it. There are neither flowers nor sexual organs present in the plants of this division: the reproduction takes place by means of *sporæ* or germs, which are either enclosed in particular cases termed *thecæ*, or imbedded in the substance of the plant. The plants of this division have been judiciously divided into three tribes:—*Fern-like*, *moss-like*, and *leafless*, flowerless plants.

I. FERN-LIKE PLANTS—FILICOIDEÆ.

FILICES.—Leafy plants, producing a *rhizoma*, either subterranean or rising into the air like the trunk of a tree: it is coated by a hard, cellular, fibrous rind, composed of the united bases of leaves: the *leaves* are either simple or variously divided, traversed by dichotomous cellular veins, with occasional ducts: *stomata* are sometimes observed on the cuticle. The *reproductive organs* consist of *thecæ*, either pedicellate or sessile, appearing on the back or the margin of the leaves, springing either from beneath the cuticle or from the actual surface of the leaves: the *vernation* is circinate.

Geo. position : Nearly general over the globe.

Yielding an acrid purgative principle :

Apidium filix mas.

Appearing as parasites in the Cinchona barks :

Hymenophyllum Tunbridgense.

Grammitis serrulata.

Asplenium pumilum.

II. MOSS-LIKE PLANTS—MUSCOIDEÆ.

MUSCI.—Cellular plants having a distinct axis of growth, with minute, imbricated, entire, or serrated leaves: *Reproductive organs* either axillary, pedicillated, hollow bodies, containing spherical or oval particles, which are emitted on the application of moisture, or urn-like *thecæ*, covered by a membranous *calyptra**, closed by an *operculum*†, and filled with sporules attached to an axis.

Geo. position: Wherever the atmosphere is humid, thence abounding in tropical forests.

Appearing as parasites on the Cinchona barks:

Lencodon tomentosus.

Leskea densa.

Hypnum Loxense. *H. Langdorsffii*‡.

HEPATICÆ. — Cellular plants consisting of an axis or stem, either leafy or bordered by a membranous expansion: the *reproductive organs* are either valved *thecæ*, supported on membranous peduncles, and containing *elateres*§, within which the sporules are intermixed, or a peltate receptacle, with *thecæ* on its under surface, or sessile, naked *thecæ*.

Geo. position: Damp, shaded places in all climates.

Appearing as parasites on bad Cinchona barks:

Iungermannia filicina. *I. Tamarisci*. *I. atrata*

Appearing as parasites on bad Cusparia bark:

Iungermannia horizontalis.

III. LEAFLESS PLANTS—APHYLLÆ.

LICHENES.—Aerial, leafless, perennial plants, spreading

* Calyptra—the interior covering of the ovarium in mosses.

† Operculum—a lid which covers the urn in mosses, and which loosens itself when the sporules are ripe.

‡ This species of *Hypnum* is found only on semiputrid, bad, pale bark; but in general the mosses do not indicate a bad quality of the bark.

§ Elateres—elastic, membranous filets fixed to placentæ in the urn of some mosses.

over almost all dry surfaces, whether of trees or stones, which are freely exposed to the light: the body of the plant consists of a cellular and fibrous, lobed and foliaceous, either hard and crustaceous or warty substance termed a *thallus*§: the reproductive organs are either *sporules*, in membranous thecæ, forming little disks or shields on the surface of the thallus, or separated cellules of the medullary layer of the thallus: both are termed generally *apothecia*||.

Geo. position: General over the globe.

Yielding fecula and a bitter principle:

Cetraria Islandica.

colouring matter:

Rocella tinctoria.

Appearing as parasites on the officinal barks of Cinchona:

*Opegrapha globosa**. *O. ovata**. *O. nana**. *O. subimmersa**.

O. farinacea†. *O. Peruviana*†. *O. rabdotis**.

*O. Condaminea**. *O. rugulosa**. *O. scaphella**.

*O. rhizocola**.

*Graphis fulgurata**. *G. exilis**. *G. cinerea**. *G. pavoni-ana**. *G. intricata**. *G. cinnabarina**. *G. hæmatites**. *G. frumentaria*†. *G. chlorocarpa**. *G. rubiginosa**. *G. nivea*†.

*Arthonia gregaria**. *A. sinensigrapha**. *A. sulfurea**. *A. marginata**. *A. obtrita**. *A. leucocheila**.

*Sarcographa Cinchonarum**.

Fissurina Dumastii.

*Chiodecton sphærale**. *C. effusum*†. *C. Meratii**. *C. depressum**.

Trypethelium variolosum†. *T. verrucosum*†. *T. chiodectonoides*†. *T. clandestinum*†. *T. sclerotium*†. *T. tetrathalamium*†.

§ Thallus.—These consist of two parts: one cortical, wholly cellular; the other medullary, cellular, and filamentous.

|| Apothecia are of various forms, and have different names; for instance, *pelta*, *scutella*, *patellula*, *cephalodium*, *tuberculum*, *trica*, *lirella*, *globulus*, &c.

* Characterising good pale bark.

† Characterising good yellow bark.

‡ Characterising good red bark.

- Pyrenula discolor*†. *P. umbrata*†. *P. clandestina*†. *P. trypanea*†. *P. annularis*†. *P. pinguis**. *P. verrucarioides**. *P. perinoides*†. *P. mollis*. *P. epapillata*†.
- Porina compuncta*†. *P. granulata*†. *P. Americana*†§.
- Verrucaria Acharii*†. *V. sinapisperma*†. *V. Cinchonæ**††. *V. catervaria*†.
- Thelotrema urceolare*†. *T. lepadinum**. *T. terebratum*†. *T. verrucosum*†. *T. myriocarpum*†.
- Ascidium Cinchonarum**††.
- Lepra flava**.
- Gassicurtia coccinea*†.
- Variolaria amara*†. *V. communis*†.
- Urceolaria cinchonarum**††.
- Lecidea aurigera*†. *L. tuberculosa*†. *L. conspersa*†. *L. duplicata**. *L. cuticula**. *L. tremelloidea**.
- Lecanora soredifera*†. *L. flavo-virens**. *L. subfusca**†. *L. farinacea**. *L. pallidiflava**. *L. Persoonii**. *L. undulata*†.
- Parmelia crenulata**. *P. glandulifera**. *P. compacta*†.
- Sticta Kunthii*†.
- Collemata azureum**. *C. diaphanum**.
- Peltigera vitellina*†.
- Borrera leucomela**.
- Ramalina Cumanensis**.
- Usnea florida**††. *U. barbata**††.
- Cornicularia Loxensis**.
- Cænogonium Linckii**††.
- Appearing as parasites on Cascarilla bark :*
- Opegrapha abbreviata*. *O. comma*. *O. calcea*. *O. heterocarpa*. *O. myriocarpa*.
- Graphis tortuosa*. *G. pachnodes*. *G. Cascarillæ*. *G. lineola*. *G. serpentina*. *G. Caribeæ*. *G. Afzelii*. *G. endocarpa*.
- Arthonia divergens*. *A. polymorpha*. *A. dilatata*.
- Sarcographa tigrina*. *S. Cascarillæ*.

* Characterising good pale bark.

† Characterising good yellow bark

‡ Characterising good red bark.

§ On Cascarilla bark.

Fissurina lactea.

Glyphis favulosa.

Trypethelium sprengelii. *T. crassum.* *T. Lageniferum,*
T. secria. *T. porosum.*

Parmentaria astroidea.

Pyrenula leucostoma. *P. endoleuca.* *P. Americana.*

Veruccaria epidermidis. *V. caduca.* *V. Gaudichaldii.* *V.*
planorbis. *V. serialis.*

Conoicarpa Cascarillæ.

Lecideæ Arthonioides. *L. vernalis.*

Parmelia perlata.

Appearing as parasites on Cusparia febrifuga :

Opegrapha Bonplandiæ. *O. epipasta.* *O. Pelletieri.*

Graphis leptocarpa. *G. glaucescens.* *G. marcescens.* *G.*
furcata. *G. rubella.*

Arthonia complanata. *A. torulosa.* *A. fuscescens.* *A. gra-*
nulosa. *A. glomerulosa.*

Fissurina Dumastii.

Chiodecton seriale.

Perynula umbrata. *P. Bonplandiæ.* *P. fimbriata.* *P. ir-*
regularis. *P. mastoidea.* *P. marginata.*

Verrucaria stigmatella. *V. glauca.* *V. thelena.* *V. decolorata.*

Thelotrema Bonplandiæ.

Myriotrema olivaceum. *M. album.*

Urceolaria viridescens.

Lecidea complanata.

Appearing as parasites on Quassia excelsa :

Opegrapha Bonplandiæ. (var. *Quassiæcola.*)

Enterographa quassiæcola.

Pyrenula nitida.

Porina Quassiæ.

Verrucaria epidermidis, (var. *Quassiæcola.*)

Parmelia minor.

Thecaria quassiæcola.

Circiaria Bertereana.

Lecideæ carneola.

Appearing as parasites on Winter's Bark :

Graphis Caribæa.

Pyrenula nitida.

FUNGI.—Cellular plants, aerial, leafless, flowerless, with no thallus nor external sporuliferous disks; the sporules lying loose among the tissue, or enclosed in a membranous case called sporidia.

Possessing astringent properties:

Boletus ignarius.

Appearing as parasites on the Cinchona barks.*

Himantia Cinchonarum.

Hypochnus rubrocinctus. H. nigrocinctus.

ALGÆ.—Leafless, flowerless plants, without any distinct axis of vegetation, growing in water: without the *reproductive* organs, or with them contained in the joints of the filaments, in *thecæ*: *sporules* without any proper tegument, germinating by elongating in opposite *directions*.

Yielding a stimulant principle:

Fucus vesiculosus.

The localities of the foregoing list of Cryptogamia plants are those fixed by M. Fee†, who first pointed out to the practitioner, as well as to the student of Materia Medica, the importance of the study of these parasites in ascertaining the relative value of the different kinds of barks employed as medicinal agents. According to M. Fee, all the specimens of Cinchona bark on which *Hypochnus* is found, are doubtful, and those which afford a locality for the *Himantia*, the *Lycoperdons*, *Collema*, and *Jungermannia*, are utterly useless; on the contrary, those may be regarded as good which display on the cuticle any of the *Graphidiæ* or the *Lecanoræ*. The Lichens on the pale Cinchona bark have, for the most part, a thin white, or whitish, rarely yellow, and still more rarely a red or reddish *thallus*: they are chiefly groups of *Graphidiæ*, *Verrucariæ*, and *Parmelaceæ*: those on the yellow Cinchona have a *thallus* of a whitish or whitish-yellow hue; they consist chiefly of specimens of *Graphis*, *Lecanora*, *Lecidea*, *Trypethelium*, *Chiodecton*, *Pyrenula*, *Verrucaria*, and *Hypochnus*: and on the red Cinchona these parasites

* Fungi indicate that the bark is of a bad quality.

† Essai sur les Cryptogammes des Ecorces exotiques officinales, 4to. Paris, 1824.

are chiefly *Thelotrema*, *Opegraphæ*, and some unknown lichens which have a peculiar thin white *thallus*, with and without a border. The Cascarilla bark is covered with *Graphideæ*, of elegant and singular formation, the white colour of the *thallus* of which is the chief source of the snowy hue of the exterior coat of the bark: now and then some yellow spots are perceived intermixed with the white, arising from the *thallus* of *Trypetheli*; but these are few compared with the *Graphideæ*. The true *Cusparia* is covered with *Graphideæ*, a few *Opegraphæ*, two *Verrucariæ*, and two *Thelotremæ*, a *Glyphis*, a *Chiodecton*, an *Urceolaria*, a *Myriotrema*, and some remains of *Sticta*, *Parmelia*, and *Jungermanniæ*: on the false *Cusparia*, on the contrary, there are rarely any parasitic plants; the tubercular, or, as it has been termed, leprous, character of the epidermis not depending on the presence of *Cryptogamia*: thence the presence or the absence of these parasites affords certain characteristics, in addition to the change of epidermis, for distinguishing the true from the false *Cusparia* bark.

SECTION III.

CHEMICAL ELEMENTS OF MEDICINAL AGENTS.

All medicinal agents, whether natural or artificial, consist of both simple and compound substances. The simple are few, and chiefly of inorganic matters; the compound belong to both the organic and inorganic kingdoms of nature. The compound bodies are either combinations of two simple substances, or they are compounds united with simple bodies or with each other; thus forming series the most extensive, which possess properties perfectly distinct from those of their components. But, although these combinations are varied, yet the elements from which they proceed are few; and the diversity of the substances, whether they be regarded in a chemical point of view, or as therapeutical agents exerting certain influences on the animal œconomy, is more the result of differences in

the proportions than in the multiplicity or the number of the elements. From a few elementary matters, indeed, are produced not only the natural substances employed as medicines, but all those also which the pharmaceutical art supplies. These elementary bodies are those which, in the present state of our knowledge, we are unable further to decompose: on this account they are regarded as simple: and, as in noticing the analyses of the various substances of the *Materia Medica*, frequent reference must be made to them, it is necessary that we should have some general knowledge of their properties.

OXYGEN*.

The most important of the elementary bodies of which I have just spoken is oxygen—a principle with which we are unacquainted except in a state of combination. It is the most widely distributed of all the elementary substances, forming a large proportion of the atmosphere, 88.9 hundredth parts of the whole of the water of the globe, and existing as a component of almost every product of the animal, the vegetable, and the mineral kingdoms. Oxygen is generally described as it exists in oxygen gas†—an invisible, inodorous, insipid, aeriform or gaseous substance, in which the oxygen is supposed to be combined with light and caloric, the principle of heat—an opinion originating from the fact, that both heat and light are evolved when the oxygen combines with other substances; such, for example, as the

* The term Oxygen is derived from the Greek words *οξύς*, acid, and *γενναω*, I generate. The experience of chemists, since the period of Lavoisier, who imposed this term, has demonstrated its incorrectness; oxygen not being the sole cause of acidity.

† Oxygen gas is usually procured from one or other of the following substances: peroxide of manganese, peroxide of mercury, deutoxide of lead, and the nitrate and chlorate of potassa. The first affords it at the cheapest rate; the last yields the purest gas. If the peroxide of manganese be used, it must be exposed to a red heat in an iron bottle, placed in an open fire, and having a tube communicating with a pneumatic trough containing inverted bottles filled with water for receiving the gas. If chlorate of potassa be used, a green glass retort is sufficient; but it should never be more than half filled with the salt.

metals, or any other combustible, for which it has a great affinity. It combines with all other elementary bodies. When these are not metallic substances, the binary medicinal compounds which it forms, with a few exceptions, are *acids*; when they are metals, *metallic oxides* are the result, including the *mineral alkalies*, and what are usually termed *earths*. The ternary and quaternary compounds, into which it enters, in many instances, display also acid and alkaline properties; as, for example, the *vegetable acids* and *alkaloids*. In the *fixed* and *volatile oils*, in *alcohol*, *ether*, *saccharine matter*, *gums*, *resins*, *balsams*, *albumen*, *gluten*, *fats*, and almost all organic bodies constituting articles of the *Materia Medica*, oxygen exists as a component.

In the formation of these combinations, when compound substances—for example, oxygen gas, or water—are employed to yield the oxygen, the effect, in some instances, is slowly and imperceptibly produced; in others, it takes place rapidly; and striking phenomena, such as the development of much caloric and light, are presented. These effects are well illustrated by the combustion of iron, or of phosphorus in oxygen gas; or the oxidation of sodium or potassium on the surface of water.

In the purest state in which oxygen is known to us, that of oxygen gas, it is combined with caloric and light; for, besides the heat and light emitted during combustion, both are extricated when this gas is forcibly compressed. Oxygen gas is heavier than atmospherical air: when the barometer stands at 30 inches and the thermometer at 60° of Fahrenheit, its specific gravity is 1.1111; and 100 cubic inches weigh 33.888 grains. Its chemical equivalent is 8.

Oxygen is essential for the vital existence of all animals and vegetables. To the former it is requisite for carrying on the function of respiration, whether performed by lungs, or through the medium of the skin: to the latter, for aiding the faculty of reproduction, and effecting the process of germination; and, in some degree, for the performance of a function, closely resembling that of insect respiration, which the leaves of plants perform during the night and in the absence of light. But oxygen, as it exists in pure oxygen

gas, rapidly exhausts the excitability of animals, and death supervenes: it is, therefore, seldom employed in this state as a medicinal agent.

HYDROGEN*.

Hydrogen is another element which is very extensively diffused; as it forms one-ninth part of all the water of the globe, and the aqueous vapour in its atmosphere, and is a component of almost every organic product. It is copiously disengaged in several pharmaceutical operations: for instance, during the action of metallic zinc in largely diluted sulphuric acid; in which case water is decomposed; the oxygen, one of the components of that liquid, unites with the zinc, whilst the hydrogen, the other constituent, is set free, and is readily collected in a gaseous state. By employing distilled zinc, the hydrogen gas is obtained pure.

Pure hydrogen gas is invisible, inodorous, and insipid, and the lightest body in nature. Its specific gravity is only 0.0694; and the weight of 100 cubic inches, referring to the composition of water†, is assumed to be 2.118 grains, at a barometrical pressure of 30 inches, and when the thermometer is 60° Fahrenheit, or sixteen times lighter than oxygen gas. 100 cubic inches of water dissolve only $1\frac{1}{3}$ cubic inch, or one 75th of its volume of this gas. It is probable that, like oxygen gas, it is a compound; but this cannot be ascertained. It does not support combustion; but it is highly inflammable whenever it comes in contact with oxygen: if mixed even with common air, and fired, a violent explosion takes place; if not mixed, the combustion is slow, and only at the point of contact of the gas and the air: in both cases water is formed. The chemical equivalent of hydrogen is 1.

* This name is derived from the Greek words *ὕδωρ*, water, and *γενναίω*, I generate.

† According to Berzelius and Dulong, 100 parts of pure water are composed of 88.9 of oxygen and 11.1 of hydrogen, or as near as possible in the proportion of 8 to 1; but eight parts of oxygen by weight occupy only one half the space of one part of hydrogen; thence it is evident that oxygen is sixteen times heavier than hydrogen.

Hydrogen exists as an element of many medicinal agents: for example, *water*, which has been already noticed, *ammonia*, and *muriatic acid*, which are binary compounds: the ternary are *alcohol*, *sulphuric ether*, *cyanuret of mercury*, all the *vegetable acids* employed as medicines, *piperina*, *salicina*, *elatin*, *wax*, *tannin*, the *fixed oils*, *camphor*, *fecula*, *gum*, *sugar*, *resins*, *balsams*, and *vegetable gluten*:—*nitric ether*, the *volatile oils*, *hydrocyanic acid*, the medicinal *hydrosulphurets*, *oil of wine*, *emetina*, the *vegetable alkaloids*, *bitumens*, *animal gelatine*, and *fats*, are quaternary compounds with hydrogen. In some of the chemical changes, also, which occur through the agency of water in pharmaceutical operations, and which depend as much on the nature of its elements as of its affinity, hydrogen plays a conspicuous part. One of these only need be mentioned at present, to illustrate this remark: thus, if bichloride of mercury be put into water, the result is a solution, not of the bichloride, but of a muriate of the metal; a portion of the water is decomposed, the hydrogen unites with the chlorine of the bichloride, forming muriatic acid, whilst the metal attaching to itself the oxygen, is converted into an oxide, and, combining with the acid, remains in solution as a muriate.

Hydrogen gas cannot support the respiration of animals, who, therefore, die when they are immersed in it: but whether this arises solely from the absence of oxygen gas, or whether the hydrogen exerts also a sedative influence on the nervous system, has not been ascertained. It is true that an atmosphere composed of hydrogen and oxygen gases, in due proportion, supports respiration; but we are still unacquainted with the effects which this gas produces on the animal œconomy.

NITROGEN*

Is another elementary substance which is known only in a state of combination. It forms upwards of 79 in every 100

* This name has originated from the fact that Nitrogen is the essential base of nitric acid: its propriety, however, is questionable; the oxygen in this case being the generator of the acid.

parts of atmospherical air, and is readily procured by whatever abstracts oxygen from common air. The simplest mode of effecting this is to burn phosphorus in a jar filled with air and inverted over water. The phosphorus, by combining with the oxygen, is converted into an acid, the phosphoric, which is absorbed by the water; the residual gas consists of nitrogen, a minute portion of carbonic acid, and a little vapour of phosphorus in solution; but after being agitated with a solution of potassa, or of lime water, nothing but pure nitrogen gas remains.

Nitrogen, as obtained in the gaseous form, is invisible, insipid, and inodorous; it is distinguished from oxygen by not supporting combustion, and from hydrogen by not being inflammable. It is lighter than atmospherical air, its specific gravity being 0.9722; and 100 cubic inches, at the barometrical pressure of 30 inches, and a temperature of 60° Fahrenheit, weigh 29.625 grains. Sir H. Davy and Berzelius have maintained that nitrogen is a compound; but their opinions are purely hypothetical. 100 cubic inches of water absorb only $1\frac{1}{2}$ cubic inch of nitrogen gas. The chemical equivalent of Nitrogen is 14.

The medicinal compounds in which nitrogen is a component are not numerous: the binary are *nitrous* and *nitric acids* and *ammonia*; there is only one ternary medicinal compound, *bicyanide of mercury*; the quaternary are *hydrocyanic acid*, *volatile oils*, the vegetable alkaloids, all the animal products, and the medicinal nitrates.

Nitrogen gas is fatal to animal life; but only from the absence of oxygen, as it exerts no injurious influence on the living system; a fact which instantly presents itself to the mind, when we reflect that it is the diluting medium of oxygen in atmospherical air.

CARBON.

The diamond is supposed to be Carbon in a state of absolute purity; the term carbon, however, is usually employed to signify the inflammable base of charcoal, which is the

residue of all animal and vegetable, and many mineral substances when they are heated to redness in close vessels.

Pure Carbon, the diamond, is prepared by the hand of Nature, crystallized in octohedrons: it is intensely hard, and refracts light powerfully; a circumstance which suggested to Newton its combustible nature. When submitted to a high temperature in oxygen gas, or with substances which freely yield oxygen, it is entirely consumed and carbonic acid is generated. The specific gravity of the diamond, thence of pure carbon, is 3.520. The chemical equivalent of carbon is 6.

Carbon is an element of many medicinal agents. The binary compounds are few:—only *charcoal*, *carbonic acid*, and pure *oil of turpentine**: the ternary are *hydrocyanic acid*, *bycyanide of mercury*, all the *vegetable acids* employed in medicine, *alcohol*, *ether*, *gum*, *secula*, *sugar*, *manna*, *tannin*, *resins*, *wax*, *elatin*, *piperina*, *salicina*, *fixed oils*, *camphor*: the quaternary are salts composed of the oxides of a metal and carbonic acid, the *alkaline carbonates*, those of *baryta*, *lime*, *magnesia*, *iron*, and *lead*: the *vegetable alkaloïds*, *oil of bitter almonds*, the medicinal *volatile oils*, and some animal products.

For many pharmaceutical purposes, pure charcoal, both of a vegetable and an animal origin, is required.

Vegetable charcoal.—The easiest method of procuring it for ordinary use is to select firm pieces of common charcoal, and, having put them into a crucible, and covered them with clean sand, to expose them for some time to a red heat. Thus prepared, it should be kept in close vessels, as it rapidly absorbs both air and fluids. For particular purposes, it may be procured tolerably pure by subjecting starch to a red heat in close vessels. Common charcoal contains a small proportion of alkaline and earthy salts; but it is free from these when obtained from the vapour of alcohol passed through a red-hot tube.

Animal charcoal.—Ivory-black is a mixture of charcoal and phosphate of lime: by digesting it in diluted muriatic

* Gay Lussac and Houton Labillardiere.—Journ. de Pharm. vol. iv.

acid, and then washing and drying it, the earthy salt is removed, and pure animal charcoal remains.

Pure charcoal is insoluble in water, and is little affected by any of the acids except the nitric, or by any of the alkalies. Besides gases and liquids, it absorbs both odorous and colouring principles from animal and vegetable matters: thence the general employment of it, particularly animal charcoal, for decolouring vegetable solutions.

SULPHUR.

Sulphur is found ready formed as a mineral production in the neighbourhood of volcanos, generally more or less chrysallized in the form of an oblique octohedron. It is also abundantly procured by exposing iron pyrites* to a red heat in close vessels†

Pure Sulphur is nearly insipid, odorous only when it is rubbed, and of a greenish-yellow colour: it is a non-conductor of electricity. Its specific gravity is 1.99: when it is melted, and the temperature raised to 450° Fahrenheit, on throwing it into water the gravity is augmented to 2.325. Sulphur melts at 216° Fahrenheit; it begins to thicken at 320°, and becomes extremely viscid before it attains its boiling point, which is 482°; from 216° to 600° it is volatilized, and condenses unchanged; but at 300°, in the open air, it takes fire. It is insoluble in water; but its vapour is soluble in vapour of alcohol; and sulphur itself dissolves in ether, and in boiling oil of turpentine. The chemical equivalent of sulphur is 16.

Sulphur is a component of a small number only of medicinal substances: the binary compounds are *sulphuric acid*, and the *sulphurets* of *potassium*, *calcium*, *antimony*, and *mercury*. Except *hydrate of sulphur*, there are none of its ternary compounds used as medicines: the quaternary are the *sul-*

* The yellow iron pyrites, bisulphuret of iron, yields the greatest quantity of sulphur.

† Sulphur is found in a pure state in the Cruciferous plants, particularly in the seeds of Mustard and those of Celery, the flowers of the Orange, the farina of Rice, the proper juice of *Ferula Assafoetida*, and of some other Umbelliferous plants, in the Rhizomes of *Alpinia galanga*, and in the roots of *Rumex patientia*.

phates of the *mineral alkalies*, of *magnesia*, *alumina*, and *potassa*, *iron*, *copper*, *zinc*, *subsulphate of mercury*: the *quinary* are the *volatile oil of mustard* and *sulphuretted oil*.

The effects of Sulphur on the animal œconomy shall be noticed in their proper place.

PHOSPHORUS*.

This element is procured by the decomposition of the phosphate of lime in bones, in which it is combined with oxygen forming phosphoric acid. Phosphorus, when pure, is nearly transparent and almost colourless, of the consistence of wax, and easily cut with a knife. Its specific gravity, at the usual barometrical pressure and temperature, is 1.7. At the temperature of 60°, in common air, phosphorus undergoes a slow combustion, although in oxygen gas the temperature for this purpose must be 80°; at 108°, in the air, it inflames; in oxygen gas the combustion is rapid and brilliant, and phosphoric acid is formed; in close vessels it fuses at 100°, and boils at 550°, rising in vapour.

Phosphorus is insoluble in water†; but it readily dissolves in hot alcohol, ether, and fixed and volatile oils. The only medicinal substances which contain it are the quaternary compounds, *phosphate of soda* and *phosphate of lime*. The chemical equivalent of phosphorus is 15.71‡.

Phosphorus exerts a powerfully stimulant influence on the animal œconomy: its effects will be noticed in their proper place.

BORON§.

Boron is a dark olive-coloured substance, procured by ab-

* Phosphorus was discovered in 1669, by Brandt, an alchemist of Hamburg, who procured it from urine.

† On this account, and to prevent the slow combustion which it undergoes in the air, it should be kept under water, and in an opaque or blackened bottle.

‡ Berzelius.

§ Boron was discovered by Sir H. Davy in 1807.

stracting the oxygen from boracic acid by means of potassium, at a high temperature. It is insipid and inodorous, a non-conductor of electricity, and unalterable in the air at ordinary temperatures; but, when heated to 600° Fahrenheit, it burns brilliantly, combining with the oxygen of the air, and forming boracic acid, which is also generated when Boron is heated with sulphuric or nitric acid, or with nitrate or chlorate of potassa. It bears an intense heat in close vessels, without being changed, except in density. It is insoluble in water and in alcohol.

The only medicinal substances in which Boron exists as a component, are the binary compound, *boracic acid*; and the quaternary, *subborate of soda*. The chemical equivalent of this element is 8.

CHLORINE*.

Chlorine is obtained by decomposing muriatic acid, which is a compound of this elementary substance and hydrogen, by means of peroxide of manganese†. It is known only in its compound state, or as a gas, which, besides the Chlorine, contains caloric and light; both of these substances being emitted when this gas is strongly and suddenly compressed.

Chlorine gas has a greenish-yellow colour, an astringent taste, and a peculiar pungent odour; its specific gravity is 2.5 : 100 cubic inches, at the ordinary barometrical pressure and at a temperature of 60°, weigh 76.25 grains. Under a pressure of four atmospheres and in a very low temperature, it assumes the form of a transparent yellow liquid.

* The appellation Chlorine is derived from the Greek word *κλωρος*, green.

† The best proportions of the above materials for preparing Chlorine gas are one part of peroxide of manganese in fine powder, and two parts of strong muriatic acid. These ingredients may be put into a tubulated retort, large enough to hold double the quantity, and having passed the beak into a pneumatic trough, containing warm water, and applied a moderate heat to the retort, the gas may be received in wide-mouthed glass bottles containing warm water. As soon as each bottle is filled, it should be immediately closed, under water, with a ground stopper, first drawing the finger round the edge with a small quantity of a lute composed of one part of wax and three of lard.

Water at 60° absorbs nearly twice its bulk of Chlorine gas, and the liquid acquires the colour, taste, and odour of the gas; it is again disengaged when this solution is heated; and when it is kept exposed to light, a portion of the water is decomposed, and, the hydrogen uniting with the Chlorine, muriatic acid is formed.

Chlorine destroys the colour of all vegetable and animal matters in a moist state or in solution; but perfectly dry Chlorine gas does not affect dry vegetable or animal colours. It is a supporter of combustion, for a lighted taper burns in it; and phosphorus, tin, copper, arsenic, antimony and zinc, when pulverized or in thin foil, spontaneously take fire, when introduced into Chlorine gas, and combine with it: its range of affinity, indeed, is most extensive. The chemical equivalent of Chlorine is 36*.

The medicinal agents of which chlorine forms a component are numerous. The binary compounds are *muriatic acid*, the *chlorides of sodium, barium, antimony, mercury*, and the *bichloride of mercury*; there is only one ternary medicinal compound, the *chloride of lime*: the quaternary are compounds of chloric and muriatic acids with oxides; *chlorate of potassa*, and *muriate of magnesia, muriate of iron, muriate of antimony, muriate of ammonia*. The *muriates of lime* and of *baryta*, as they are aqueous solutions, are senary compounds; and this is also the case with the *muriates of morphia, strychnia, cinchonia*, and *quinia*, which are crystallized salts.

Chlorine has a powerful influence on the animal œconomy, as shall be noticed in its proper place.

IODINE†.

This elementary substance was not known until 1812, when it was discovered by M. Courtois in preparing carbonate of soda from *kelp*, the ashes of Fuci and other marine plants. He observed that the residual or mother liquor corroded me-

* Dr. T. Thomson.

† The term Iodine is derived from the Greek word *ἰώδης*, violet-coloured.

tallic vessels; and, in experimenting to ascertain the cause of that corrosion, he found that sulphuric acid precipitated from the residual liquor a dark-coloured, metallic-like matter, which the application of heat converted into a beautiful violet vapour*. Iodine is usually prepared by adding diluted sulphuric acid in excess to the above-mentioned residual liquor, then boiling, and afterwards leaving the whole at rest for some time, and filtering. Peroxide of manganese, in the proportion of 1000 grains for every twelve fluid ounces of the liquor, is added to the filtered fluid, which is now a solution of hydriodic and sulphuric acids. The mutual reaction of the peroxide and the acid decomposes the whole of the hydriodic acid, the hydrogen of which combines with the oxygen of the peroxide, and forms water; whilst the iodine, thus set free, is sublimed, by the application of a moderate heat, into a cool receiver, and sulphate of manganese remains. The Iodine is afterwards purified by mixing it in water, containing five parts of potassa, and re-subliming.

Iodine is an opaque, bluish-black, scaly, crystalline substance, with a metallic lustre, an acrid taste, and the odour of chlorine, but less pungent; staining the fingers brownish-yellow, and having a specific gravity of 4.948. It is a non-conductor of electricity, and a negative electric. At a heat much under 212° , it sublimes; at $224\frac{1}{2}^{\circ}$ it fuses, and boils at 347° : it is distinguished from all other substances by the rich violet colour of its vapour, and by its property of uniting with starch and forming a compound of a deep blue colour. This test detects the presence of Iodine in a liquid containing 1.450.000 of its weight. It requires for solution 7000 parts of water, to which it communicates a brownish tint: alcohol and ether dissolve it readily, forming deep reddish-brown solutions.

The chemical equivalent of iodine is 124†: its range of affinities is very extensive.

The medicinal agents in which Iodine exists as a component are very few: the binary compounds are the *iodides*

* For Courtois' Experiments, see Ann. de Chimie. tome 89, 90, 91; and for those of Sir H. Davy, Phil. Trans. 1814-15.

† Gay-Lussac, T. Thomson.

of *lead* and of *mercury*; there are no medicinal ternary compounds; the quaternary are the *tincture of iodine* and the *hydriodate of potassa*.

Iodine acts as a powerful stimulant on the animal œconomy: its physiological action and therapeutical influence shall be noticed in their proper place.

METALIC ELEMENTS.

The description of elementary bodies which come under the denomination of metals, differ in certain properties from all other substances. They possess *lustre*, pervading every part; *opacity*, even when they are reduced to extreme thinness; *weight*; *tenacity*, or the power of resisting the influences which tend, mechanically, to separate their particles from one another; and *fusibility*. Some of them possess, also, *malleability*, or the property of being expanded under the hammer; and *ductility*, or the capacity of being drawn out into wire. They differ from one another in the degree in which they possess these properties. Some of them are always found in a state of combination; others frequently in a pure state.

a. Metallic Elements which are found only in a State of Combination.

POTASSIUM.

Although the oxide of Potassium, potassa, has been known from a very early period, yet its metallic or elementary base was unknown until 1807, when it was discovered by Sir Humphrey Davy. It is procured by decomposing potassa or its carbonate, by means of charcoal, according to a process suggested by M. Brunner*, and afterwards modified by Wohler.

* Quarterly Journal of Science, vol. xv. and xxii.

Potassium is an opaque, crystalline metal, resembling mercury in colour and lustre, its specific gravity is 0.865, at 60° Fahrenheit and under the ordinary barometrical pressure. It is a good conductor of electricity. At the temperature of 32° Potassium is brittle, at 60° it becomes soft like wax, at 70° acquires a degree of fluidity, and at 150° is perfectly fluid. Its chief characteristic is its powerful affinity for oxygen; by which means it cannot be preserved except under naphtha. From the same cause, it rapidly decomposes water: much heat and light is extricated, hydrogen gas is evolved, and the metal, being oxidated, is converted into potassa. This is rendered evident by burning Potassium on an infusion of red cabbage, which is turned green as the alkali forms.

The binary medicinal compounds in which this element exists are *potassa*, and the *sulphuret* and *bisulphuret of Potassium*: there are no ternary compounds: the quaternary and the quinary are salts composed of *acids* and the oxide or potassa. The chemical equivalent of Potassium is 40.

Potassium is not employed in its uncombined state as a remedial agent.

SODIUM.

This elementary substance was also discovered by Sir Humphrey Davy, nearly about the same time that he discovered potassium. It may be prepared by decomposing, with the aid of heat, the chloride of Sodium by means of potassium: the latter is converted into a chloride, and the Sodium procured in its pure state.

Sodium resembles silver in its colour and lustre: its specific gravity is 0.972. At the ordinary temperature of the air it is soft, and may be moulded like wax: it fuses at 200°, and is volatilized in a full red heat. It has a powerful affinity for oxygen, which it attracts rapidly from the air; and, like potassium, it is also oxidized when placed upon the surface of water; but the decomposition of the liquid is less rapid, and no light is visible, unless the water be hot, when a few scintillations appear. In both instances soda is generated; but,

when Sodium is burnt in pure oxygen gas, a peroxide of an orange colour is formed.

The medicinal binary compounds of Sodium are *soda* and *chloride of Sodium*: there are no ternary compounds; and the quaternary and quinary, like those of potassium, are salts composed of acids and the *oxide* or *soda*. The chemical equivalent of Sodium is 24.

Sodium is not employed in medicine in its uncombined state.

BARIUM.

This metallic element was also discovered in 1808 by Sir H. Davy. It is procured by decomposing the carbonate of baryta. He formed the carbonate into a paste with water, placed it on a platinum tray, and laid a globule of mercury in a little hollow on the surface of the paste; the positive pole of a powerful galvanic battery was then brought into contact with the tray, and the negative pole with the mercury. The oxygen of the baryta was thus disengaged from the Barium, which amalgamated with the mercury; and, by afterwards distilling this amalgam, so as to drive off the mercury, the Barium was obtained in its metallic state.

Barium is of a dark grey colour, with little lustre, and considerably heavier than water. It is rapidly oxidized in the air, and also by decomposing water when it is thrown into that liquid: in both cases baryta is produced.

The only binary medicinal compounds of this element are the *chloride of Barium* and the *oxide* or *baryta*; and the only salt, medicinally used, into which it enters, is the *muriate*, a compound of the muriatic acid and baryta. The chemical equivalent of Barium is 70.

CALCIUM.

Calcium was first procured by Sir H. Davy, by a process similar to that by which he obtained barium. From the minuteness of the quantity in which it has hitherto been pro-

cured, its properties are little known, except that by exposure to the air it is oxidized and converted into lime.

The binary medicinal compounds of Calcium are the *chloride of Calcium* and the *oxide or lime*; the only ternary compound is the hydrate, or slacked lime; the *carbonate* and the *muriate* are salts of lime with acid bases. The chemical equivalent of calcium is 20.

MAGNESIUM.

If chloride of magnesia, mixed with potassium, be subjected to a red heat in a porcelain tube, the chlorine quits the Magnesium and is taken up by the potassium: on washing out the chloride of potassium, the Magnesium set free is obtained in the form of minute brown scales, which leave a metallic trace resembling lead when they are pressed in a porcelain mortar. At a high temperature, Magnesium attracts oxygen and is converted into magnesia. It was first procured, by the galvanic influence, in the same manner as calcium and barium, by Sir H. Davy, who discovered this element.

There is only one binary medicinal compound of Magnesium, the *oxide or magnesia*; the saline compounds, the *carbonate* and the *sulphate*, are salts of the oxide. The chemical equivalent of Magnesium is 12.

Magnesium is not used in its uncombined state in medicine.

ALUMINIUM.

This elementary, metallic base has been procured, in a pure state, by Wohler from the decomposition of alumina by potassium, in the form of a grey powder, or rather in small scales of a colour and lustre resembling tin. It requires a very high temperature for fusion: in its fused state, it is a conductor of electricity. It takes fire at a red heat in the open air, burns with a vivid light, and is converted into alu-

mina: in pure oxygen gas, the combustion is brilliant, and the emission of heat intense: it is also feebly oxidized in water, which it decomposes; but only at the boiling point. Its action on water is greatly aided by dilute sulphuric and muriatic acids, solutions of potassa and ammonia.

There is no medicinal compound in which Aluminium is an immediate component. In alum, the oxide is united with sulphuric acid. The chemical equivalent of Aluminium is 10.

ZINC.

Zinc is procured from its native sulphuret, *zinc blende*, or from its native carbonate, *calamine*, of which there are several varieties. In reducing the ores, which are put into a covered crucible with a tube fixed in its bottom, the Zinc, when separated, is volatilized, driven through the tube and condensed in a separate vessel. It is purified by another distillation into a receiver containing water.

Zinc has a bluish-white colour, a strong metallic lustre, and a specific gravity of 7. It is acted on by the file with difficulty: it is malleable and ductile at temperatures between 210° and 300° ; but, at a low or a high degree of heat, it is brittle. It fuses at 608° Faht.; and, on slowly cooling, it crystallizes in hexagonal prisms. At the ordinary temperature of the air, it scarcely attracts oxygen; but, at a high temperature, it rapidly combines with oxygen; and, at full redness, it burns with a vivid, white flame.

The protoxide is the only binary compound of Zinc medically employed: there are no ternary compounds: in the quaternary, the Zinc is indirectly as an oxide combined with acids. The chemical equivalent of Zinc is 34. Metallic Zinc exerts no action on the animal system.

b. Metallic Elements which are occasionally found in a Pure State.

IRON.

Iron is the most abundant of metals, being found, in one

form or another, in almost every part of the world. It is procured in the native state ; and in combination with sulphur, with oxygen, and sometimes with saline bodies : it also forms a component of many plants ; and there is much reason for believing that the red colour of animal blood is due to an oxide of iron. For the purposes of medicine and of commerce, metallic Iron is procured chiefly from common clay iron-stone, red hæmatite, brown hæmatite, and black magnetic iron ore. The first yields about thirty-five per cent. of Iron ; the others about seventy per cent. In all, the Iron exists in combination with oxygen as a peroxide.

Iron is extracted from these and other ores by reducing them to powder, mixing this with charcoal and lime, and exposing the whole to an intense heat in a furnace. In this process, the lime and the charcoal take the oxygen from the iron, which is fused and falls to the bottom of the furnace ; it is there protected from the action of the air by the fusible *slag* which is formed by the carbonaceous flux combining with the impurities of the ore. The fused Iron is let off by a hole in the bottom of the furnace ; but it is not pure : to free it from carbon and any unreduced ore, it is again exposed to a strong heat with a current of air playing upon its surface, which reduces the undecomposed ore whilst the carbonaceous matter is burned. The solid Iron thus obtained is afterwards hammered and rolled to increase its tenacity and render it malleable Iron.

Native Iron is rare. A specimen, about four pounds in weight, was found in the mine of Hackenberg ; and another in the mine of Johanner, near Kamsdorf, in Saxony. Those singular metallic masses that have fallen from the atmosphere, in various parts of the world, and which are called aerolites, are nearly pure Iron, with a small admixture of another metal, nickel, which distinguishes aerolites from true native Iron.

Pure Iron is a hard, ductile, malleable, and very tenacious metal, of a peculiar, grey colour, susceptible of a high polish. In its purest state it is scarcely fusible ; but, when heated to redness, it softens. The specific gravity, at 60° under an ordinary barometrical pressure, is 7.7. It is attracted by the

magnet, and may itself be readily rendered permanently magnetic. It has a strong affinity for oxygen, and attracts it from the air when moisture is present: it also decomposes watery vapours, at all temperatures, forming *rust*, which is a hydrated-peroxide of Iron. When heated to redness in the air, it is rapidly oxidized; and in oxygen gas it burns with vivid scintillations.

Iron is present in several medicinal substances and preparations. The binary compounds containing it as a direct component are the *sulphuret* and *bisulphuret*, and the *protoxide*: in the salts, the *carbonate*, *sulphate*, and *tartrate*, and in the preparation termed *ferrum ammoniatum*, it exists only as an indirect component. The chemical equivalent of iron is 28.

Iron, both in its pure and its combined state, is medically employed; but it exerts no physiological action on the animal economy in its metallic state, unless it meet with acid in the stomach.

ARSENIC.

Arsenic is found native; but commonly in combination or alloyed with iron, cobalt, silver, or gold, or united with sulphur, in the shape of arsenical pyrites, or that of realgar. The former occurs in Sicily, Italy, Hungary, and Germany; the latter chiefly in Hungary and in Turkey in Asia. A native oxide is also found in Germany; but it is rare.

Arsenic, in its metallic state, is found in different parts of Germany, in masses more or less considerable, having, when the masses are fresh broken, a brilliancy and a lustre equal to that of silver; but quickly becoming tarnished when exposed to the air.

Metallic Arsenic may be obtained by calcining any of the ores, in conjunction with charcoal: it is also procured by decomposing the white oxide or arsenious acid, by means of twice its weight of the black flux*; the metallic Arsenic is sublimed

* Black flux—a compound of two parts of crude tartar and one part of nitre deflagrated together.

when the crucible containing the mixture acquires a red heat, and is condensed in an empty crucible inverted above the former and kept cool*.

Arsenic is a brittle metal, of a bluish white or steel gray colour, brilliant, inodorous, and insipid; of a specific gravity 5.8843: when suddenly exposed to a white heat, it inflames and burns with a bluish white flame; but when the heat is not more than 356° , it rises in vapour and emits a strong odour of garlic, which distinguishes it from all other metals. This odour is perceived only at the commencement of the oxidizement of the metal, which cannot be volatilized in the open air without undergoing oxidation. This volatility prevents Arsenic from fusing, except under a very high pressure. It attracts oxygen slowly from the air at 60° , losing its lustre and falling into a black powder; and it is also slowly oxidized and dissolved when it is boiled in water.

The only medicinal agent in which Arsenic exists as an element is *arsenious acid*, which is a binary compound of Arsenic and oxygen. The chemical equivalent of Arsenic is 38.

Metallic Arsenic exerts no influence on the living animal system.

ANTIMONY.

Antimony is found native at Sala in Sweden, and in the Hartz mountains. It also occurs in combination with oxygen, and mixed with other metals: but the most abundant of its ores is the sulphuret, from which the metallic Antimony of commerce is derived. For procuring metallic Antimony, the native sulphuret is decomposed by heating it in covered crucibles with half its weight of iron filings: the sulphur com-

* In a large way, the distillation is performed in earthen retorts coated with a mixture of clay, iron filings, blood, hair, and alum: and a sheet of iron, rolled up as a cylinder, is used as an adapter. When the distillation is finished, and the apparatus is quite cool, and this iron cylinder is unrolled, the arsenic is found sublimed upon it in brilliant crystals.

bines with the iron, whilst the metallic Antimony fuses, collects at the bottom of the crucible, and is drawn off into moulds*.

Metallic Antimony has a lamellated structure, a silvery hue running into bluish gray, and displays considerable lustre. It is brittle and pulverulent, inodorous and insipid; yet, when rubbed between the fingers, it communicates to the skin both a peculiar taste and smell. Its specific gravity is 6.702. It tarnishes and is slightly oxidized when exposed to a moist air. It fuses at 810° Fahrenheit, and, in a full white heat, when exposed to the air, inflames and burns with a brilliant white light; and the condensed vapour is a protoxide of the metal.

The only medicinal agents in which Antimony exists, as a direct component, are the *sulphurets* and the *chloride*, which are binary compounds: the *hydro-sulphurets*, and the other preparations in the Pharmacopœias, are quaternary and quinary compounds. The chemical equivalent of Antimony is 44.

Metallic Antimony exerts no action in the animal economy.

BISMUTH.

This metal is found, both native and in combination with other substances, chiefly at Schneebery in Saxony; but some is furnished by Cornwall. Its ores require little more than the application of heat to run the metal from the matrix in which it is embedded.

Bismuth is a brittle, reddish-white metal, having considerable lustre and a lamellated structure. When slowly cooled, it crystallizes in octohedrons. Its specific gravity, at the ordinary pressure and temperature of the atmosphere, is 9.850. It is malleable when warm, fuses at 476° Fahrenheit, and sublimates in close vessels at 30 Wedgewood. It scarcely acts upon the air at common temperatures, but, when fused, it takes its oxygen rapidly; and, when heated

* On a large scale, at Riom and Clermont in Auvergne, the sulphuret is first roasted in a reverberatory furnace, then mixed with argol, and the mixture smelted, in a melting pot, in a wind furnace.

to sublimation, in the air, it burns with a bluish flame, and emits fumes of the oxide. It readily decomposes nitric acid, and the oxide thus formed dissolves in the acid.

The only medicinal compound of this metal is the *sub-nitrate*, which is a quaternary compound. The chemical equivalent of the metal is 72.

Metallic Bismuth has no action on the living animal system.

COPPER.

Copper is found native in Cornwall*, and in many other parts of the world; and sometimes, particularly in Siberia, it appears crystallized: it also exists in the form of an oxide, most abundantly in combination with sulphur; and in a saline state. The most common of the ores is the sulphuret named copper pyrites, from which the metal is separated by long-continued roasting in reverberating furnaces, during which the sulphur is driven off, partly as sulphur, partly as sulphurous acid. The residue is then oxidized in calcining furnaces, and afterwards smelted with charcoal, which reduces it: but as it still retains both sulphur and iron, it is strongly heated with a current of air playing on its surface, which oxidizes the sulphur and iron, whilst the Copper is left in a state of tolerable purity.

Pure Copper is a hard, elastic, sonorous metal, of a reddish-orange colour, insipid, and inodorous except when much rubbed: it is susceptible of a high polish. It is both ductile and malleable, and nearly as tenacious as iron. Its specific gravity is 8.667. It fuses at a bright red heat. It suffers little change in a dry atmosphere, but is oxidized and converted into a carbonate in moist air. It is an important practical fact, that it is scarcely attacked by sulphuric or muriatic acids, and not at all by vegetable acids if air be excluded: but when the air is not excluded, the Copper is

* It is a curious fact, that, notwithstanding the great abundance of copper and tin in Cornwall, it is stated by Cæsar, that all the brass used by the Britons, at the time of the Roman conquest, was imported — See Commentaries “de Bello Gallico.”

rapidly oxidized and salts are formed. It rapidly decomposes nitric acid under all circumstances.

There are no binary medicinal compounds of copper: the *sulphate* is a quaternary compound of the peroxide; and also the *carbonate* contained in ammoniated copper: the *acetate* is a quinary compound. The chemical equivalent of the fluid is 64.

Metallic Copper does not act on the animal economy: instances having occurred in which coins had been swallowed and remained for months in the intestines without producing any injury or inconvenience to the person.*

LEAD.

Lead is very rarely found in a pure state. Its most abundant ores are sulphurets; but it is found also combined with oxygen, and in a saline form. All the lead of commerce is procured from *galena*, a sulphuret found very generally throughout the world; and abundantly in this country, in Northumberland, Cumberland, Durham, and Yorkshire. In Northumberland this ore is roasted in a reverberating furnace; it is then smelted on a low blast furnace along with lime, which decomposes a quantity of sulphate of lead formed during the roasting.

Metallic Lead is a soft and flexible, inelastic metal, both malleable and ductile. Its specific gravity is 11.55. The surface, from exposure to the air, is generally covered with a white efflorescence, which is carbonate of lead: but, before this occurs, and on a fresh-cut surface, the lustre is considerable. Lead is inferior in tenacity to other ductile metals. It fuses at 612°; may be heated to whiteness in close vessels without subliming; and, when slowly cooled, it crystallizes in octohedrons. It is quickly oxidized at high temperatures. When submersed in distilled water it undergoes no change, but when placed partly in air, partly in water, in open ves-

* Thomson's Conspectus of the Pharmacopœias; Art. Copper. Paris' Pharmacologia, p. 250. *Orfila*, Toxocol. Générale, i, p. 500.

sels, it is quickly oxidized at the point of contact of the air and the water, and carbonate of lead is formed. It rapidly decomposes nitric acid; and the metal is oxidized at the expense of the acid.

Two of the binary compounds of Lead are medicinal agents:—the *iodide*, and the *protoxide* or *litharge*; the saline preparations of the *acetate*, *subacetate*, and *carbonate*, are quaternary, or combinations of the oxide with the acetic and carbonic acids. The chemical equivalent of Lead is 104.

Pure metallic lead is not poisonous when taken into the stomach; but, as it is scarcely ever free from the carbonate, it may prove deleterious; indeed, the carbonate is the only direct poison of lead, a fact which I have clearly ascertained, and shall demonstrate in its proper place.

MERCURY.

Mercury is found in various parts of Europe, particularly in Spain, Germany, and Hungary; in South America; in the Phillipine isles, and also in China. The most productive mines are those of Idria, of the Palatinate, and of Guanica Velica, in Peru. Mercury is found native in most of the mines; and, in some, it is in the state of an amalgam with silver; but the most common form in which it is found, is that of native cinnabar, a sulphuret of the metal. The metal is extracted by subjecting the ore, mixed with lime or iron filings, to the action of heat: the lime, or the iron, combining with the sulphur, sets the Mercury free to be volatilized in the metallic state.

The distinguishing characteristic of Mercury is the fluidity which it maintains at common atmospheric temperatures. It has a white colour and a strong lustre, and its purity is ascertained by the complete mobility of all its particles. It becomes solid or congeals at forty degrees below Zero, and contracts greatly at the instant of congelation: in this state it is malleable and may be cut with a knife. The specific gravity of fluid Mercury is 13.5, that of solid mercury 15.612. At 68° Fahrenheit, this metal boils, and is volatilized.

Pure Mercury is not oxidized by exposure to air and moisture at an ordinary temperature ; but, in a temperature sufficient to volatilize the metal, it is converted into a peroxide. Mercury decomposes the sulphuric and nitric acids ; but it does not affect any other acid.

The medicinal agents in which Mercury exists as a compound, are numerous : the binary compounds are the *chloride* and *bichloride*, the *iodide*, *sulphuret*, *bycyanide*, *protoxide*, and *peroxide* ; the salts, which are also numerous, are quaternary compounds of acids and the oxide. The chemical equivalent of mercury is 200.

Although the preparations of mercury are most active medicines, yet, the metal itself exerts no influence whatsoever on the living system.

SILVER.

This metal is most abundantly procured in tropical regions : it occurs native both massive, dendritic, and crystallized ; and in combination with other metals, as gold, antimony, arsenic, bismuth, lead, iron, and copper. Sulphur is also a component of some ores of Silver. The greater part of the Silver of commerce is obtained from native Silver and its sulphurets. The ore is reduced to fine powder, mixed with sea-salt, and exposed to heat in a reverberating furnace : a sulphate of soda and a chloride of silver are thus formed ; the whole is then ground together, and the powder, being mixed with mercury, water, and fragments of iron, is put into barrels which revolve by means of machinery. The chlorine of the chloride of Silver is taken by the iron, which is thus converted into a soluble salt, and the Silver amalgamates with the mercury, which is afterwards separated by distillation, leaving the Silver in a pure state.

Pure Silver is a soft, malleable, ductile, very tenacious metal, of a clear white colour, and susceptible of a high polish. Its specific gravity, at the temperature of 60° and the ordinary barometrical pressure, is 10.5. It fuses at 20 Wedgewood ; and in a very high temperature is volatilized. It does not decompose air or moisture ; and, even in the melted state, when it is exposed to a current of oxygen gas,

it is not permanently oxidized: it acts upon none of the acids except the sulphuric and the nitric, the latter of which is its proper oxidizing agent and solvent.

The only preparation of Silver medicinally used is the *nitrate*, which is a quaternary compound of the protoxide and nitric acid. The chemical equivalent of Silver is 110.

TABLE of the Weights, Specific Gravities, Fusibility, and Volatility, of the Chemical Elements of Medicinal Agents.

Elements.	Weight of 100 cubic inches in grs	Specific gravity.	Chemical equiva- lents.	Point of fusion.	Point of volatilization.
Oxygen	33.888	1.1111	8	—	—
Hydrogen	2.118	0.0694	1	—	—
Nitrogen	29.652	0.9722	14	—	—
Carbon	—	3.520	6	—	—
—(<i>in vapour</i>)	12.708	0.416	—	—	—
Sulphur	—	1.99	16	216° F.	216° to 600° F.
Phosphorus	—	1.7	15.71	108° F.	550° F.
Boron	—	—	8	—	600° F.
Chlorine	76.25	2.5	36	—	—
Iodine	—	4.948	124	227° F.	350° F.
—(<i>in vapour</i>)	262.612	8.716	—	—	—
Potassium	—	0.865*	40	136° F.	below red heat.
Sodium	—	0.972*	24	190° F.	below red heat.
Barium	—	—	70	—	—
Calcium	—	—	20	—	—
Magnesium	—	—	12	—	—
Aluminium	—	—	10	—	—
Iron	—	7.788†	28	130. W.	—
Zinc	—	6.861 to 7.†	34	698° F.	—
Arsenic	—	5.8843‡	38	—	388° F.
Antimony	—	6.702†	44	below red heat	—
Bismuth	—	9.822†	72	480° F.	—
Copper	—	8.895§	64	27. W.	—
Lead	—	11.352†	104	500° F.	—
Mercury	—	13.568†	200	−39° F.	650° F.
Silver	—	10.474†	110	20. W.	—

* Gay Lussac and Thenard.

† Brisson.

‡ Turner.

§ Hatchett.

SECTION IV.

CLASSIFICATIONS OF MEDICINAL AGENTS, FOUNDED ON THEIR OPERATION.

The advantages of an arrangement of Medicinal Substances, or, in other words, of the *Materia Medica*, founded on their medicinal operation, is undoubted. Thence it is, that he who would acquire an accurate acquaintance with the nature and properties of medicinal substances must not only draw largely on the stores of Natural History and Chemistry; but, in order to comprehend the laws of the action of medicinal agents on the living system and their therapeutical influence in disease, he must also have recourse to the aid of Anatomy and Physiology.

The Arrangement of Medicinal Substances adopted in this volume is founded upon the basis of their operation on the body; and is that which I follow in my lectures. Before explaining the principles which have regulated its formation, I shall present my readers with the two best modern classifications of medicinal substances, and offer a few comments upon each of them, to justify the alterations which I have made in framing my own.

The first of the two classifications to which I have alluded is that of Dr. Young, as exhibited in the following table :

I. CHEMICAL AGENTS.

1. *Caustics.*
2. *Antiseptics.*
3. *Antidotes.*
4. *Demulcents.*
5. *Diluents.*

II. VITAL AGENTS.

A. SUPPORTING STRENGTH.

1. Nutrients.

B. CAUSING ACTION.

PARTIAL AND TRANSIENT	1. <i>Expergeficients.</i>	12. <i>Hydragogues.</i>
	2. <i>Excitants.</i>	13. <i>Simply Propellents.</i>
	3. <i>Calefacients.</i>	14. <i>Anthelmintics.</i>
	4. <i>Sudorifics.</i>	15. <i>Diuretics.</i>
	5. <i>Errhines.</i>	16. <i>Carminatives.</i>
	6. <i>Sialogogues.</i>	17. <i>Emmenagogues.</i>
	7. <i>Expectorants.</i>	18. <i>Epispastics.</i>
	8. <i>Stomachics.</i>	19. <i>Suppuratories.</i>
	9. <i>Emetics.</i>	20. <i>Sorbeficients.</i>
	10. <i>Cathartics.</i>	21. <i>Astringents.</i>
	11. <i>Chologogues.</i>	
PERMANENT	} <i>Tonics.</i>	

C. DIMINISHING ACTION, or SENSATION.

Primarily	1. <i>Narcotics.</i>	2. <i>Sedatives.</i>
	3. <i>Nauseants.</i>	4. <i>Diaphoretics.</i>
Secondarily	} <i>Exhaurients.</i>	

III. INSENSIBLE AGENTS.

Specifics.

In the foregoing table, Dr. Young has arranged all the objects of *Materia Medica* under three distinct heads: Chemical Agents, Vital Agents, and Insensible Agents. The propriety of the first and second of these primary divisions cannot be denied; but, as the existence of specifics is questionable, the third is certainly objectionable. The arrangement, however, of the classes is even less commendable than that of the primary divisions. The first division contains five classes, two only of which, Caustics, and Antiseptics if any really exist, can be correctly considered as operating

chemically on the body. With respect to the class Antidotes, it is only necessary to remark, that all substances which may be considered as such do not act chemically; and it is still more difficult to comprehend how Demulcents and Diluents can be regarded as chemical agents. The second division, *Vital Agents*, is less objectionable; but it is too much subdivided, and contains too many classes. In the second section of this division, entitled "causing action," we find Expergi-facients, Excitants, and Calefacients, as distinct classes, which is not easily understood, as the terms are nearly synonymous, and the same medicines must be arranged under each to answer the indications implied. The class Chologogues or purgers of bile, cannot properly be separated from Cathartics, all of which, as they operate more or less on the duodenum and the gall-ducts, may, in fact, be regarded as Chologogues. The same remarks apply to Hydragogues; for as Cathartics, except those of the mildest description, never operate without throwing off a large portion of fluid by the bowels, a distinct class of Hydragogues is superfluous. The class Suppuratives consists of substances which are, in fact, merely varieties of Epispastics. In the second section, therefore, of this division, the first, the eleventh, the thirteenth, and the twentieth classes might be advantageously omitted; and, with equal benefit, the class Exhaustients, in the third section, might be expunged. No class should be admitted in any arrangement of *Materia Medica* which is not essentially different from the others; nor any which is founded on the basis of hypothesis. In my opinion, Dr. Young has judiciously separated Narcotics from Sedatives, for reasons which I shall afterwards have occasion to detail in speaking of my own arrangement.

The following table displays the second of the Classifications to which I have alluded, that of Dr. Murray.

A. GENERAL STIMULANTS.

a. Diffusible.	{ Narcotics.
	{ Antispasmodics.
b. Permanent.	{ Tonics.
	{ Astringents.

B. LOCAL STIMULANTS.

Emetics.
 Cathartics.
 Emmenagogues.
 Diuretics.
 Diaphoretics.
 Expectorants.
 Sialogogues.
 Errhines.
 Epispastics.

C. CHEMICAL REMEDIES.

Refrigerants.
 Antacids.
 Lithontriptics.
 Escharotics.

D. MECHANICAL REMEDIES.

Diluents.
 Demulcents.
 Emollients.
 Anthelmintics.

This Classification of Dr. Murray is also framed upon the basis of the operation of the substances employed as remedial agents; and, with a few exceptions, is almost as perfect as the present state of the healing art will admit. Objections, nevertheless, have been advanced to some of its classes, and to the positions which others hold. Thus, the position of the class Refrigerants among the chemical remedies has been justly criticised; and the fallacy of the views upon which its place has been allotted to it by Dr. Murray shall be pointed out when the period for treating of Refrigerants arrives. A tenable objection has also been made to the class Lithontriptics. No medicines introduced into the stomach have yet succeeded in wholly or partially dissolving calculi, existing either in the pelvis of the kidneys or in the bladder of urine; although it is said to be a well-attested fact, that the angles and asperities on the surfaces of calculi have been occasionally smoothed down by the long-continued administration of some of the substances included in this class. Means, also, have been devised for applying substances known to dissolve calculi out

of the body directly to calculi contained in the urinary bladder. But, unless the evidence of their solvent powers were conclusive, a class of Lithontriptics is scarcely admissible. Upon the whole, however, Dr. Murray's Classification is superior to any of its predecessors; and it will be seen that I have adopted it as the general basis of my own arrangement.

In framing the table which will be found at the end of this section, although I have taken advantage of the arrangements of Dr. Young and of Dr. Murray, yet, it will be obvious to my readers that my view of the subject is different from that of either of these distinguished medical philosophers. I have adopted one of the primary divisions of Dr. Young and two of those of Dr. Murray: arranging the whole of the *Materia Medica* under *Vital*, *Chemical*, and *Mechanical Agents*. In the first of these divisions, I have discarded many of the classes of Dr. Young, and have altered the position of others. I have also changed the situation which Narcotics, Antispasmodics, and Refrigerants, hold in Dr. Murray's arrangement; and have divided the class Narcotics, into Narcotics properly so called, and Sedatives. With regard to the propriety of this disunion, I trust that I shall be able to convince my readers that there are medicinal substances which diminish or destroy the *irritability* and *sensibility** of the body; and, consequently, lessen the action of the heart and arteries, both in strength

* As these terms will frequently recur, it is proper that the reader should be fully aware of what is intended to be understood by them in the following pages.

Irritability is that property of some organic structures, connected with or dependent on vitality, which renders them capable of being excited to contraction, either on the application of external stimulants, or by the will. It is displayed particularly in the muscular fibres; and, to use the language of Blumenbach, "is marked by an oscillatory or tremulous movement, differing from the action of simple contractility, both by occurring far more easily on the application of any pretty strong stimulus, and by being attended with a much more considerable constriction." Some physiologists—as Haller and Bichat, for instance—have attributed this solely to the fibres of the muscles; and regarded it as altogether independent of the nervous system. Others—as Dr. Whytt and Cullen—on the contrary, considered it as dependent on the nerves distributed to these organs.

The theory of Haller rested chiefly upon the fact, which he had observed, that

and frequency, or extinguish it altogether, without having caused any perceptible previous excitement: such medicines are, therefore, justly entitled to the appellation Sedatives. With regard to Refrigerants, which I have removed from amongst the chemical remedies in Dr. Murray's table, there can be no

contraction cannot be produced in the heart, and other involuntary muscles, by the application of stimulants to the trunks of their nerves; from which, and from the results of his experiments, he was led to believe that the irritability of the muscular fibre is a vital property, peculiar to muscles, of a nature different from sensibility, and not derived from the nervous system; whilst, at the same time, he admitted that the voluntary muscles, besides this inherent irritability, possess also a *vis nervosa*, or contractile power, excitable by stimulants applied to their nerves. The most untenable part of this theory is undoubtedly that which attributes the *vis nervosa* to the muscular instead of the nervous fibre. It is probable that Haller was led into this inadvertency from losing sight of the suggestion of Erasistratus and Galen, which has been verified by Sir C. Bell's discoveries, that there are distinct nerves of sensation and of motion. When we reflect that the nervous system was then supposed to be possessed of the same powers, in all its parts, it is easy to conceive that a physiologist, when he saw motion rendered evident without sensation, should conclude, as Haller did, that both irritability and the *vis nervosa* resided in the muscular fibre.

To the same source we may trace the error into which Dr. Whytt has fallen, in combating the theory of Haller, when he asserts that the motions of stimulated muscles proceed from their sensibility; that the irritability of the muscular organs of the body is in proportion to their sensibility; and, consequently, that whatever augments the sensibility of muscles, increases their irritability; whatever diminishes their sensibility, lessens or wholly destroys their irritability. It is certain that many of the experiments of the present period, particularly those of a galvanic nature, tend to confirm the opinion that *irritability* is a property inherent in, and peculiar to, the muscular tissue.

But, perhaps, the most powerful argument that can be advanced in favor of this proposition may be drawn from the fact, that, when paralysis ensues on tying or dividing the nervous trunks of a muscular organ, the irritability continues vigorous for a considerable time afterwards.

It would be out of place here to proceed further with this argument: I have, therefore, merely to state, that by the term *Irritability* I mean that *vital* property of organic structures which renders them capable of being excited.

The term *Sensibility* has been employed by Chaussier, a French physiologist of great eminence, and by some other physiologists, to express that faculty, which every living fibre possesses, of changing, by any impression or contact, its habitual and natural harmony or disposition of parts; thus making it equivalent to contractility and irritability conjoined. This, however, is not the sense in which the word will be employed in this volume; but, approximating to the common acceptance of the term, I shall use it to express that property of the animal body, dependent on the nerves of sensation, which is the cause of a perception in the mind when a stimulant is applied to a part furnished with certain nerves. This change in the corporeal organ is always accompanied by a definite idea; and

doubt that they ought to be placed under the head of vital agents diminishing action, when we consider the effects of cold in lowering the powers of life. Thus, a stream of cold water directed upon the crown of the head, and continued for a considerable time, is a sedative of such power

the same idea is the necessary sequence of the same action, whether this be the result of the application of any external stimulant or an internal cause, as long as the organ on which the impression is made remain in a healthy condition. It is unessential for the truth of this position, to determine in what the change upon the extremity of the sentient nerve consists, and in what manner it is propagated to the brain; whether by a vibratory movement in the nervous cord, or the undulatory action of a fluid contained within it, or the power of electricity conveyed along it. All that is certainly known is, that the change is the result of a specific action on certain nerves only; and this is necessary to be always borne in remembrance. This fact, which the experiments of Sir Charles Bell have firmly established, first suggested itself to Erasistratus*; but, so little was his opinion the result of anatomical enquiry, that he imagined that the nerves of sensation originated in the membranes, those of motion in the substance, of the brain. Galen maintained a similar opinion regarding two sets of nerves, and supposed that the sensory nerves arise from the cerebrum, the motory from the cerebellum†. These opinions were revived by M. Ponteau‡, M. Lecat, M. Morin, and other moderns: however, they can only be regarded as happy conjectures: nor do they, in the smallest degree, detract from the merit of the distinguished physiologist who has confirmed the vague ideas of the antients by the only path which can lead to truth—that of experiment and observation§.

All sensation is undoubtedly dependent on the presence of nerves; and every hour's experience confirms the opinion of Galen, that the degree of sensibility which any part of the body possesses is proportional to the number of nerves which it receives.

That sensibility is distinct from *irritability* is evident; for a muscle, in which all *sensation* is destroyed by a division of the sensitive nerve supplying it, is, nevertheless, still irritable, or enjoys the capacity of being stimulated to contraction. Sensibility is, therefore, a matter of consciousness: irritability is not necessarily so; but, in a part which is endowed with both, the former is greatly heightened in an increased state of the latter. Thus, on a highly irritable surface, impressions which, in a more healthful state of the part, would be either indifferent or pleasurable, excite pain and often inordinate action. *Sensibility*, as I employ the term, differs further from irritability and contractility in being peculiar to animals; whereas both irritability and contractility are properties of all organized bodies, whether animals or plants.

* Rufus Epesius, de Partibus Hominis, p. 65, edit. Lond. 1726.

† Galen de Anatomicis adminis. lib. vii, viii, quoted by Dr. J. Thomson in his life of Cullen, vol. i, p. 205, 207.

‡ Œuvres Posthumes, t. ii, p. 480.

§ Exposition of the Natural System of the Nerves, 8vo. London, 1824.

that it immediately subdues the excitement of Phrenitis; instantly reduces the morbid strength of the most athletic; and is, consequently, dangerous when incautiously employed. But it may be said that cold, in a diminished degree, exerts a tonic influence. This is correct: nevertheless, its depressing influence, and that also of those remedies which produce a cooling effect upon the body when taken into the stomach, is so striking, that I consider myself warranted in placing Refrigerants in the same division as Sedatives; that is, under the head of Vital Agents which operate on the nervous system by diminishing action. The substances in the first division of general Vital Agents, therefore, those influencing the body generally by operating directly upon the nervous system, possess two distinct modes of acting: one which may be regarded as *positive*, which is followed by excitement; the other as *negative*, which is followed by immediate collapse: and it is from a conviction of the accuracy of this view of the subject, that I have arranged them as they stand in my table.

The manner, however, in which remedies that augment action exert their influence is not the same in all of them; and, consequently, subdivisions were requisite. I have, therefore arranged the classes according as the substances which they include operate directly on the *nervous* system; or, through its influence, on the *muscular* and the *sanguiferous* systems: or on the *secerning* system.

I am perfectly sensible of the impossibility of strictly arranging the classes according to physiological principles. Thus, the Class Sialogogues might have been included in that of Excitants: but, as the most striking effect of the former is produced upon the salivary glands and the secreting organs, I have preferred making the direct Sialogogues a distinct class, and placing it in the third subdivision. In the same manner, several of the other classes may be regarded as entitled to rank in other subdivisions as well as in that in which they appear: but it is impossible, in any arrangement, to take under consideration all the variations which may present themselves. The chief object of any classification is to enable the student to pursue his investigations with method; and I trust that the one which I have

adopted will prove adequate for this purpose. It is not offered as a *perfect* classification; on the contrary, I am satisfied that the progress of *Materia Medica* will unveil its defects.

In the second general division of the table, that intended to comprehend those medicines which influence the state of the body, or its contents, by their *chemical* properties, I have kept in view only those medicines the primary action of which is chemical; the body or its contents being regarded as one of the agents of the action induced. Thus, as far as regards Escharotics, the chemical affinities of the substances employed are sufficient to overcome the preservative influence of the vital principle; and the solid parts of the body enter into combination with these substances, in the same manner as if they did not form a portion of the living system. I have subdivided this division, therefore, according to the nature of the chemical action of the substances contained in it. Thus, Escharotics exert a solvent power, and combine with the animal matter; or rather, by a resulting affinity, separate the elements of the part to which they are applied, and cause them to enter into new combinations.

In the same manner, the action of Antacids and Antalkalies is as truly chemical as if the operations, instead of taking place in the body, were performed in the laboratory. The influence of Antilithics is not so obvious, and their mode of action not so readily explained; but it is undoubtedly, at least in part, chemical.

In making these general remarks on the second class of my arrangement, however, it is necessary to admit that the remedial effects of some of the substances arranged under it are not confined to their chemical action. Thus, the benefit derived from the operation of an Escharotic does not result from the chemical phenomena which accompany it, but from the stimulus which it causes operating as a counterirritant; the chemical action being no further remedial than as it produces the eschar by the sloughing of which the issue is to be formed: it is the counterirritation which is the remedial power. Neither can the beneficial influence of Antilithics be wholly

ascribed to their chemical properties ; somewhat is due to the tone which they impart improving the digestive function and preventing that ascendent state of stomach which favours the deposition of calculous matter in the urinary organs.

Little remains to be said respecting the third class of this arrangement, which cannot be regarded as of an active nature. The medicines arranged under it operate rather by a kind of *negative* property, not affecting either the nervous system or the simple animal fibre directly, than by any quality inherent in themselves. They prove beneficial by diminishing the action of acrid and stimulating matters upon diseased surfaces ; and effect this by interposing themselves, as it were, between the acrid and stimulating matters and the sentient extremities of the nerves of the organs to which they are applied : they may, therefore, be regarded as mere mechanical agents, although it be not easy to explain their influence upon distant parts with a reference solely to their mechanical action, unless we refer to those in the class *Diluents*, which, being taken into the circulating mass, and carried to every part of the habit, act on each organ as if they were immediately applied to it.

I have purposely avoided extending the following table by introducing the subdivisions of the classes ; conceiving that the student will derive more advantage from tables of these placed at the head of each class, than if they were crowded into the general table.

It is only necessary to remark farther, in this place, that each Class will be divided into three primary divisions, according as the medicinal agents are *organic products*, or *inorganic* substances, or *mental agents*. Some objections may be advanced to the last of these divisions : but, as mental agents have a powerful influence in the removal of diseases, they become instruments in the hands of the physician as applicable, in a therapeutical point of view, as the material articles of the *Materia Medica* ; and, consequently, when they present themselves, they will form a third and distinct division of the class.

TABLE OF CLASSIFICATION.

I.—VITAL AGENTS ;

A.—Influencing the body generally ;

a.—by operating directly on the nervous system :

* *increasing action.*

Excitants.

* * *diminishing action.*

{ *Primarily.*

{ Sedatives.
{ Refrigerants.

{ *Secondarily.*

{ Narcotics.
{ Antispasmodics.

b.—on the muscular and sanguiferous systems :

Tonics.

Astringents.

c.—on the secerning system :

Errhines.

Sialogogues.

Expectorants.

Emetics.

Cathartics.

Diuretics.

Emmenagogues.

Diaphoretics.

B.—Influencing the body solely by their action on the part to which they are applied.

Epispastics.

a. Rubefacients.

b. Vesicants.

c. Actual Cauterants.

II.—CHEMICAL AGENTS ;

A.—Influencing the state of the body, or its contents, by their chemical properties :

* *acting on the surface.*

Escharotics.

a. Potential Cauterants.

* * *on the contents of cavities.*

{ Antacids.

{ Antalkalies.

a. Antiseptics.

{ Antilithics.

III.—MECHANICAL AGENTS :

Demulcents.

Diluents.

PART III.

SECTION I.

FIRST DIVISION—VITAL AGENTS.

THE application of the term *Vital Agents*, in the present instance, is confined to substances which operate upon living animal structures. The animal body is composed of solid and of fluid parts, displaying, in a general point of view, the same physical properties as all other solid and fluid matter. Thus, every solid part of the body is an aggregation of molecules, which do not separate from one another, except by the influence of some agent acting upon them, either within or without the body; and the whole is made up of such aggregations, differing in *consistency*, *elasticity*, and *tenacity*, under the form of bone, muscle, membrane, ligament, and nerve. So far animal structures correspond with inert matter; but they differ from it in one essential; their solidity does not wholly depend on physical causes. In inorganic bodies the force of cohesion is the sole power which maintains them in a state of solidity: but in organized bodies this is altogether secondary to that unknown principle which we denominate *life*, which is obvious to us by its effects, although its nature will probably for ever remain utterly insolvable by the powers of human reason. If, for example, a muscle be separated from one of its attachments in an animal body, and as great a weight appended to it as it can support, it will be found that the same muscle, after having been wholly separated from the body, for a space sufficient to destroy its vitality, but not to permit of decomposition, will be unable to support the weight which it sustained in the first instance, or when alive: clearly demonstrating that the principle of vitality has more

power in maintaining the integrity of animal structures than cohesion. It is upon animal structures, imbued with this principle, that the medicines which we are about to examine under the title *Vital Agents* operate; and, when this principle is withdrawn, these agents cease to influence the animal solid. But it may be reasonably enquired—do these agents operate upon the gross structures, or only upon the nervous and muscular fibrils, or, as they have been termed, the primary solids? There can be one answer only to this query, which is—vital agents operate only on the primary solids.

No notice, it may be said, has been taken of the influence of vital agents in changing the state of the fluids. The omission has been intentional; for I am of opinion that no proposition is more firmly established than that advanced by Dr. Cullen—that “the medicines which act upon the fluids, do so, commonly, in consequence of acting on the solids.”

Another question here presents itself—do vital agents produce their effects by a direct or immediate action upon all of these primary solids? Is the muscular fibre affected by the direct operation of the stimulant upon it, independent of the nerves, which, there is every reason for believing, accompany it in every structure into which it enters in the organism of the body? There is more difficulty in replying to this question than to the former; and it would be digressing too widely from our proper subject to venture upon an examination of the facts which lead to the conclusion, that the cellular and the muscular fibre are affected by medicinal agents chiefly through the medium of the *nerves*. It is only necessary to remark, that no efforts have yet succeeded in separating the nervous from the muscular and cellular fibrils; and that muscular action is greatly modified by causes operating primarily on the brain, or on nerves leading to the muscles, whether the action be voluntary or sympathetic; and this fact of itself is sufficient to justify the inference, that those medicinal agents, termed *vital*, influence the body chiefly by their action on the nervous system. This opinion, indeed, is founded upon the same basis as the Pathology which now almost universally regulates the opinions of the

profession ; and which arose with the ideas first taught by Hoffman regarding the nervous origin of diseases.

Admitting that the action of medicines almost wholly depends upon motions excited in, and propagated by, the nervous system, the medicines capable of inducing such motions operate either generally, or upon particular parts. Those which, however, it must be remarked, influence the body generally, exert also a primary action on particular parts ; and this may either be directly on the nervous system, on the muscular and sanguiferous systems, or on the secerning system. In whatever manner the impression is made, the energy of the whole nervous system is excited ; and it is by this means that the various effects which result from the administration of medicinal agents are produced in the different parts of the system.

It was at one time supposed that the energy of the whole nervous system depends on the brain ; and even Dr. Cullen remarks, in speaking of the operation of medicines, that “ all powers, noxious and salutary, operate not only upon the parts to which they are applied, but also upon distant parts of the system, and that by the intervention of the brain ; and these causes are therefore to be considered as exciting the action of that organ.” It has also been supposed that sympathies can only be explained by admitting that the primary impressions of external agents act on the brain ; and that it is from the reaction of this organ that subsequent motions are produced in other parts of the system. But there are exceptions to this explanation of the communication of impression made by vital agents on particular parts : for, without referring to the lower animals, those placed in the class *Vermes* of Linnæus, and the *Radiata* of Cuvier, in which there is no brain, we find, in man himself, that the powers of the brain are shared by the spinal marrow ; and it is not impossible that, although the nerves are, properly speaking, *transmissive* organs, yet, that *they* themselves are possessed of a certain degree of power, independent of that either of the brain or of the spinal marrow. 'This is rendered evident by the observations made on acephalous infants, in some of which, although the brain was altogether wanting,

yet, not only the instinctive functions were performed, but food was taken ; which undoubtedly implies some degree of consciousness. “ By shewing us,” as Mr. Lawrence has justly remarked, “ what happens when an important organ is wanting or malformed, it contributes to fix our opinions respecting its uses*.” The independence of the nerves on the brain is also partly confirmed by the experiments of Fleurens, Rolando, and other continental Physiologists, in removing portions of the brain. The experiments of Mr. Brodie and those of M. Gallois have farther proved that, in particular, the action of the heart is carried on completely independent of the brain ; and, in fact, that the source of the motion of the heart is an influence exerted upon it by the medulla spinalis.

But this is not the place to notice these investigations: it is enough for us to know that those substances which are comprehended under the term *Vital Agents* produce their effects by influencing the nervous energy—that power inherent in the brain, the medulla spinalis, and the nervous system generally, by which not only all the vital actions are maintained, but through which, also, we are willing, moving, and conscious beings.

* Medico-Chirurgical Transactions, vol. v. p. 176.

SECTION II.

EXCITANTS—MEDICAMENTA EXCITANTIA*.

Syn. Stimulants.

Excitants may be defined “Substances that augment, powerfully, the motions peculiar to the different organs of the body, by a primary impulse on the sensibility and irritability of the part to which they are applied, communicated by the nerves to the whole system.”

Almost all substances that operate as Excitants have some sensible properties in common. They impart a warm or an acrid impression on the organs of taste; and, when they are of a vegetable nature, they generally have a fragrant odour—qualities, in fact, resident in that class of vegetable bodies which we term aromatics. These qualities have been regarded by several writers on the *Materia Medica* as constituting the essential properties of every stimulant. There are, nevertheless, inorganic Excitants which, correctly speaking, have neither taste nor odour; as, for example, *Caloric* and *Electricity*; but the impulse which they give to the nervous system differs rather in degree than in kind from that which is communicated by an aromatic substance. In the vegetable kingdom, it is probable that the exciting agent is *volatile oil*. Almost every stimulant vegetable product yields this in greater or less abundance; and, whenever it can be isolated from the other principles of the plants which contain it, we always perceive that it produces all the exciting effects of the entire plants in an increased degree. It is true, there are some vegetable Excitants in which no volatile oil, strictly so called, is found: but these furnish a principle analogous, in its effects, to volatile oil.

The inorganic substances belonging to this class of medi-

* From the Latin word *excitare*, to excite, awaken.

cines appear to have no principle in common to which their action can be referred.

The general effects of Excitants are very obvious. They consist in—1. a greater susceptibility of impression in the nerves ; 2. an increase of action in the moving fibres ; 3. an acceleration of the frequency, and an augmentation in the force of the pulse ; 4. a higher degree of the temperature of the body. The organs upon which they chiefly display their influence are those of digestion, circulation, respiration, and secretion. Their effects are also displayed powerfully on the cerebral system. In small doses the action of Excitants is scarcely perceptible, and is confined to the surface on which they are received : in large doses they become obvious, not only to the individual excited by them, but to others, and the effects of their action is extended over the system. In still larger doses, their effects assume the character of disease. Thus, the first effect experienced after taking a strong Excitant is a sensation of heat and acrimony in the gullet, extending to the stomach and causing thirst instead of hunger : the digestive function is evidently suspended ; and nausea, sometimes vomiting, supervenes ; the substance, if not ejected, is next rapidly carried into the duodenum, and increases the peristaltic movement of the intestinal canal. These effects, however, do not always depend on the extent of the dose ; but, in many instances, on the state of the body.

1. *Effects of Excitants on the Digestive Organs.*—Excitants, when taken into the *stomach*, exert their primary action on that organ ; a sensation of heat is experienced, which the person affected instantly refers to the stomach ; and it is probable that the mucous membrane, if the viscus could be seen, would be found redder than natural and more sensitive, and the muscular coat contracted. If the stomach be empty, a sensation of hunger is felt ; and if food be immediately taken, or if the exciting substance be swallowed directly after taking food, the digestive faculty is rendered more active. From the stomach, the impulse is communicated to the rest of the system ; but the general effect is not, in every case, commensurate to the impression

made upon the stomach; and many substances act powerfully on the general habit, which display little influence on the organ receiving their primary impulse. If Excitants pass the pylorus without acting on the stomach, their influence on the general system is less than when their primary impression is made on that organ. The cause of this is connected with the functions of the part and the nature of the stimulants that thus operate. As far as regards the functions of the part, the natural effect of a stimulant on the intestinal canal is to increase its peristaltic motion; the stimulating substance is, consequently, carried forwards; and although it continues its impulse as it proceeds, yet, this is too transitory to be very influential. As far as regards the nature of the stimulants that thus act, if they are vegetable substances, the aromatic principle is so involved in other matters that the digestive process must be carried to a certain extent before it is evolved; and this does not happen until it passes out of the stomach.

Some stimulants, chiefly those of an inorganic nature, exert little influence until they are taken into the circulation; thence they may be said to communicate their impulse directly to the heart and arteries. Some other organs, also, in the vicinity of the stomach are affected by contiguity; for instance, the liver, if in a healthy state, has the activity of its secretory function increased; and it is also probable that the pancreas and the spleen are more or less affected. In whatever manner, and on whatever part the impulse is first impressed, it is rapidly communicated to the rest of the system.

2. *On the Circulating and Respiratory Organs.*—The influence of certain impressions on the stomach is to augment the force of the heart and arteries in affecting the circulation of the blood: thence, when an Excitant is swallowed, it renders the pulse both quicker and stronger than before; and the impulse thus given is extended even to the capillaries. Red blood is impelled into channels in which, under ordinary circumstances, it is absent; the skin is therefore reddened, its temperature elevated; and, if the dose of the stimulant be considerable, restlessness, watchfulness, and headache supervene. These effects are necessarily propor-

tionate to the dose of the Excitant ; but other circumstances also, in some degree, modify these effects. Thus, Excitants act with much energy in persons of sanguine temperament, as far as concerns the circulating system ; whereas, in those of an opposite frame of body, their power upon the heart and arteries is often scarcely perceived. The influence of mental Excitants, in this respect, is remarkably exhibited in blushing, palpitation of the heart, and that sensation of a glow of heat overspreading the chest which often attends highly agreeable or pleasurable feelings.

The natural consequence of an accelerated condition of the pulse is an increase in the movement of the thorax : a greater number of inspirations and expirations than usual occur in a given time ; thence a more complete change takes place in the blood circulated through the pulmonary vessels. It is from observing these phenomena, that Excitants are asserted to influence the respiratory organ.

3. *On the Secerning System.*—I have already stated that Excitants taken into the stomach increase the action of the capillaries ; thence they awaken, as it were, the activity of the secretory and exhalant systems. Excitants act powerfully on the kidneys ; and, therefore, as we shall afterwards find, all Diuretics are Excitants : on which account, some volatile oils, when taken in a large dose, cause distressing effects upon the urinary organs.

As a part of the discerning system, also, the skin feels powerfully the influence of Excitants, and the exhalants throw off a large quantity of fluid in the form of sweat.

4. *On the Nervous System.*—Almost immediately after any exciting substance, in a sufficient dose, is taken into the stomach, the impulses communicated to the nerves of that organ are transmitted to the rest of the body, developing vital energy in the various anatomical centres to which the nerves relate.

We cannot explain this power of transmitting impressions inherent in the nerves. We acquire no information from our knowledge of the structure of the nervous tissue :—from the brain to the minutest nerves, we find that it is constituted of two distinct substances ; one, apparently, consisting

of a congeries of blood vessels, of a grey or cineritious colour ; the other firm, white, and composed of minute and delicate fibres : both, however, are essential to the structure of an organ destined to perform specific functions. With this structure we find two distinct functions united, both dependent on vitality, the nervous and the sensorial power : it is to the first of these that we are accustomed to refer the faculty of transmitting impressions received in one part of the system to other parts ; and it is through it, consequently, that the animal is connected with the external world ; of which, indeed, we can be conscious only by the diffusion of the impulses received from external objects on particular parts of the frame, to other parts, or to all its parts. Whether this communication is made through the medium of a nervous fluid, or whether it is a mere oscillation, or a property analogous to the galvanic or electrical influence, or whether it is made by any other material agent, we know not : our information extends no farther than the fact, that an impulse communicated to one set of nerves, those of the stomach, for instance, is transmitted to the rest of the body, through the medium of the nerves ; but the nature of the communication is still involved in mystery. There is one curious fact, which would lead us almost to conclude that the transmission of volition, and that of mere impulses neither affording sensation nor connected with volition, depend on distinct circumstances : it is that, after the death of an animal, the muscles, which during life are subservient to the will, contract when their nerves are subjected to galvanic power ; but the involuntary muscles cannot be thus excited, although for many hours after death the heart, which is an involuntary muscle, can be excited on the contact of a mechanical or a chemical agent. In the brain itself the influence of Excitants is manifested by the perceptions becoming more vivid, the imagination more pregnant with ideas, and those of a more brilliant and exalted character : thence the medicines belonging to this class were denominated exhilarants by the ancients. Indeed, it is impossible to deny that the employment of stimulating substances, within a certain limit, often produces the happiest inspirations and the most de-

lightful sensations. The influence of Excitants on the brain becomes most manifested when they are administered in large doses: these being followed by vertigo, temporary delirium, and a change in the perceptions; or, in other words, inebriety. Whether the cerebellum is affected in a manner similar to that of the brain, is uncertain, but there is no doubt that some Excitants affect in a special manner the medulla spinalis, and through it the sensitive nerves of the skin, as shall be made evident under the account of Strychnia. This power, however, of augmenting the general sensibility, is common to all Excitants, although it is possessed in a higher degree by some stimulant substances than by others.

Upon the whole, the influence of Excitants is always more or less perceptible in their effects on the organic functions: on the digestive function they are displayed by the food being more quickly and completely digested; on the circulating, by the blood being formed in more abundance, more florid, richer in colouring matter, and moved with more rapidity; on the respiratory, by the greater freedom of movement of the thorax, and the glow which pervades its cavity; and on the secreting, by the increase both of the secretions and the excretions. The excitement of the brain and the spinal marrow is evidenced by the greater susceptibility to impressions in the nerves of every part of the body; and by a higher degree of intellectual energy, displayed not only in the acuteness of perception, but in the facility of separating and arranging ideas.

Excitants, besides differing in their effects according to the part of the system on which their specific impression is made, differ, also, as far as concerns their degree of force or power. The same Excitant, also, acts differently according as it is combined with different substances: and different Excitants, in different quantities, produce different effects. They differ, also, in the rapidity with which their effects are produced; some being almost instantaneous, others requiring some time; and this altogether independent of the nature of the part to which they are applied. The force or violence of their effects is generally in the ratio of the degree of the

rapidity of their action; and the continuance of the impression is, also, in some degree, connected with the same circumstance; since we invariably observe, that the most powerful stimulants, those the action of which is the most rapid, are followed most quickly by a state the opposite of action—that of collapse. It is this result of Excitants that distinguishes them from some other medicines which also increase action, and especially tonics; but, if it enable us readily to recognize them in a class so closely allied to them, it increases the difficulty of separating them from another class, that of Narcotics, which at first quicken action, but soon afterwards exhaust greatly both sensibility and irritability. On this account we should have a clear conception of what is understood by the term *collapse*.

It is evident that the expressions *excitement* and *collapse* are merely terms relative to some given standard, or to some point which, in the healthy system, can be considered neither. With respect to Excitement, “if,” to borrow the language of Dr. Cullen, “we take the lowest, every higher degree than that must be called a degree of excitement; and, if we take the highest degrees, and consider the lower degrees that may take place while life still subsists, every lower may be called a degree of collapse.” As the terms are meant to be employed in these pages, Excitement implies every state of the nervous system in which the energy of the brain is greater than that which, in the waking state of a healthy man, is exactly adequate to the ordinary functions of the system; Collapse that state in which the cerebral energy is so much diminished as to suspend the exercise of the functions of sense and volition—a state of defective activity of the brain, similar to that which causes sleep, only in an augmented degree. There can be no doubt that a certain supply of blood to the brain is essential for the support and continuance of its function: too great an increase of the momentum produces *excitement*; a diminished afflux, on the contrary, within certain limits, or an exhaustion of the moving powers from previous over-exertion, is productive of *collapse*.

From what has been stated, this fact may be collected—

that there is a distinction between what are termed general excitants and those which belong exclusively to this order of our arrangement.

There is also, as I have already stated, a distinction between these and tonics; although this difference is chiefly in degree; but to this distinction I must add, that they differ, also, in the nature of their effects. Excitants increase the mobility of the system; Tonics augment the strength of the muscles: Excitants exhaust the excitability; Tonics, within a certain limit, maintain it: the action of Excitants is immediate, powerful, and transitory; that of Tonics is slow, almost imperceptible, and progressive, but permanent. The necessity, therefore, for separating these two classes of medicinal agents must be obvious.

With regard to the state of the habit in which Excitants are useful as remedial agents, we may advance this as a general principle—that it is that state in which powerful and sudden impressions on the system are required; in which, from some cause, the functions of the brain and nervous energy are diminished; and in which the impulse of the blood on the brain, necessary for its healthful action, is greatly defective. This state is, in truth, one of direct debility of the brain: and that it depends on a deficient impetus of the blood to that organ may be inferred from the fact, that a state closely resembling it is induced by pressure on the carotids; and, when this impetus is excessive, so as to produce convulsions, these are stopped by whatever diminishes the action of the heart, as, for instance, blood-letting; and they have, also, been stopped by compression on one or both carotids. The renewal of this impulse is to be obtained by increasing the general momentum of the blood; and this is most quickly induced by the application of Excitants to the nerves of the stomach, and to those of the Schneiderian membrane and of other parts on which their influence is direct, and can be immediately impressed. Some objections might be raised against this explanation of the mode in which the increased momentum is said to be produced by those who contend, and justly so, that the brain exerts very little influence over the action of the heart and arteries; but, when we consider the

momentary influence which the passions exert over the heart during perfect health—when we reflect on the magnitude of the cardiac nerves and the sympathy that exists between the heart and other organs in relation to its momentum—we shall have little hesitation in admitting that Excitants, operating on the blood-vessels, produce their effects chiefly through the influence of some portion of the nervous system. The sensible demonstration of the effect of Excitants on the heart and arteries is the increased power and fulness of the pulse.

The number of substances which may be classed as medicinal Excitants is considerable. They may be arranged under three distinct heads: *Organic Products*, *Inorganic Substances*, and *Mental Excitants*.

TABLE OF EXCITANTS.

* ORGANIC PRODUCTS.

α.—VOLATILE OIL—

* *Uncombined, obtained from—*

Carum <i>Carvi</i> .	5. 2.	†Umbelliferæ†.
Pimpinella <i>Anisum</i> .	—.	—.
Anethum <i>graveolens</i> .	—.	—.
———— <i>Fœniculum</i>	—.	—.
Melaleuca <i>Cajuputi</i> .	18. 3.	Myrtaceæ.
Citrus <i>Aurantium</i> .	18. 2.	Aurantiaceæ.
———— <i>Medica</i> .	—.	—.
Ruta <i>graveolens</i> .	10. 1.	Rutaceæ.
Lavandula <i>spica</i> .	14. 1.	Labiataæ.
Mentha <i>piperita</i> .	—.	—.
———— <i>viridis</i> .	—.	—.
———— <i>pulegium</i> .	—.	—.
Origanum <i>vulgare</i> .	—.	—.
Rosmarinus <i>officinalis</i> .	2. 1.	—.

† Class and Order in the Linnean System.

‡ Natural order.

* * Combined :—in

Roots*	Aristolochia <i>Serpentaria</i> .	20.	6.	Aristolochiæ.
	Acorus <i>Calamus</i> .	6.	1.	Aroideæ.
	Zingiber <i>officinale</i> .	1.	1.	Scitamineæ.
	Curcuma <i>longa</i> .	—.	—.	—
Wood	Laurus <i>sassafras</i> .	9.	1.	Laurineæ.
Barks	— Cinnamomum.	—.	—.	—
	Drymis <i>Winteri</i> .	11.	1.	Winteræ.
	Canella <i>alba</i> .	—.	—.	Meliaceæ.
Flowers	Caryophyllus <i>aromaticus</i> .	12.	1.	Myrtaceæ.
	Crocus <i>sativus</i> .	3.	1.	Irideæ.
Fruit	Eugenia <i>Pimenta</i> .	12.	1.	Myrtaceæ.
	— Cubeba.	2.	3.	Piperaceæ.
	Laurus <i>nobilis</i> .	9.	1.	Laurineæ.
Seeds	Elettaria <i>Cardamomum</i> .	1.	1.	Scitamineæ.
	Myristica <i>Moschata</i> .	22.	8.	Myristaceæ.
b.—CAMPHOR—obtained from				
	Laurus <i>Camphora</i> .	9.	1.	Laurineæ.
	Dryobalanops <i>Camphora</i> .	13.	1.	Dipterocarpeæ.
c.—ACRID OIL.—contained in				
	Piper <i>nigrum</i> .	2.	3.	Piperaceæ.
	— <i>longum</i> .	—.	—.	—
	Sinapis <i>nigra</i> .	15.	2.	Cruciferæ.
	Anethemis <i>Pyrethrum</i> .	19.	2.	Compositæ.
d.—BITTER EXTRACTIVE—contained in				
	Dorstenia <i>Contrayerva</i> .	4.	1.	Monimieæ.
e.—STRYCHNIA.—obtained from				
	Strychnos <i>nux vomica</i> .	5.	1.	Strychnaceæ.

f.—ALCOHOL.

* Uncombined.

Pure Alcohol.

* * Combined.

Ardent spirits.

Wines.

Cider

Beer.

Mead.

* Under roots are comprehended rhizomes and tubers.

g.—SULPHURIC ETHER.

** INORGANIC SUBSTANCES.

a.—ELECTRICITY.

(*Galvanism.*)

b.—CALORIC—in Hot air baths ;

- water baths ;
- vapour baths ;
- medicated baths.

c.—IODINE.

* *Uncombined.*

1. in substance.

** *Combined* :—by

1. trituration.

a. with Lead.

b. — Mercury.

2. affinity—

a. with Potassium.

3. solution.

a. with Alcohol.

d.—MERCURY.

I. ——— *combined with Oxygen.*

† *protoxide* prepared by

1. trituration

a. with saccharine matter.

b. — unctuous substances.

c. — Ammoniacum.

d. — Carbonate of Lime.

e. — Carbonate of Magnesia.

2. decomposition.

†† *peroxide* prepared by

1. the action of Heat and Air.

2. ——— Nitric acid.

II. ——— *oxidized and combined with acids.*

† *protoxide.*

1. with Nitric acid.

2. — Acetic acid.

†† *peroxide*.

1. with Sulphuric acid.
2. — Muriatic acid and Ammonia.

III. ———— *combined with Chlorine*.

† *protochloride* prepared by

1. sublimation ;
2. precipitation.

†† *perchloride* prepared by

1. sublimation.

IV. ———— *with Sulphur*.

1. by trituration ;
2. sublimation.

V. ———— *with Cyanogen*.

1. by decomposition.

VI. ———— *with Iodine*.

1. by trituration.

e.- AMMONIA :

Carbonate of Ammonia.

*** MENTAL EXCITANTS.

Joy.

Impetuosity.

ORGANIC VEGETABLE SUBSTANCES WHICH OPERATE AS EXCITANTS.

VOLATILE OIL. *Oleum volatile*. (Syn. *Essential oil*).—Volatile oil is secreted by vegetables, and is, in many instances, deposited pure in leaves, flowers, and fruits, either in peculiar vesicles on the surface, or in cells in the substance of the vegetable body ; in many instances it is diffused through the plant in combination with other principles. On this account I have arranged the varieties of volatile oils employed as Excitants under two heads : *uncombined*, or deposited in distinct cells ; and *combined*, or intimately united with other principles.

The odour of plants and their parts is chiefly owing to the exhalation of these oils : some plants are odorous from the

spontaneous exhalation of the oil; in others the cells require to be ruptured by friction or otherwise, before this odour is perceived. The influence of light and heat appears to favour the formation of volatile oils; thence the plants of tropical climates yield them in the greatest abundance. Their ultimate components are Carbon, Hydrogen, Oxygen, and in general Nitrogen, but not in every instance: and it is probable that they derive their origin from already elaborated juices. They differ from one another in composition.

The *uncombined* Volatile Oils can readily be procured from the plants in which they are secreted, either by simple expression, or by distillation with water or with watery vapour. The oil and water pass over together; but after a short time they separate, the oil collecting either on the surface or settling at the bottom of the water, according to its density. When procured in a separate state, volatile oils are of various consistence, some are as liquid as water, preserving their fluidity at low temperatures; others become concrete at a temperature considerably above the freezing point; others crystallize by slow evaporation; some have the viscosity of oil; and some the consistence of butter.

Every Volatile Oil, whatever may be its consistence, contains two distinct parts: one, a volatile, odorous liquid; and the other a concrete, often crystalline, inodorous substance. The first may be regarded as the Volatile Oil in its extreme purity; the second a substance dissolved in the former, and separating by time and rest. Bizio and Boullay* imagine that these are distinct principles, constituents of every volatile oil, and have named the first *Igreusine* and the second *Sereusine*†. I am not prepared to accord with this view of the subject. Instead of which, I am disposed to regard the solid matters deposited from volatile oils to be either *Camphor* or *Benzoic acid*.

The purest Volatile Oils are limpid, and, when first drawn, many of them are nearly colourless; and it is probable that the green, blue, and yellow colours, which some of them display,

* Journal de Pharm. 1829, p. 167.

† Herberger has named it *Stearopton*.

are not present with them in the cells of the plants, but are merely elevated with them in the process of distillation. Their taste is acrid and penetrating; their odour fragrant, but of the most varied description. The extreme minuteness of the particles of the volatile oil producing the odour of some plants is beyond the utmost stretch of the imagination: its exhalation continues, and the odour is perceptible for a long space of time. Thus, a few leaves of the *Woodroof*, *Asperula odorata*, a small perennial plant, found in woods and shady places in hilly districts, which has no odour in the fresh state, but is very fragrant when dried, will continue to exhale their odour for many years after they are gathered.

Some Volatile Oils, as those of Cloves, Cinnamon, and Sassafras, are heavier than water; but the majority of them, the oils of Lemon, Orange, Lavender, Rosemary, Peppermint, Caraway, and others, are lighter than that fluid. Those which are the products of plants of temperate climates are the lightest*. They are all insoluble in water; although, when agitated or distilled with it, they are suspended in it in minute globules, rendering the water, for some time, milky, and communicating to it their *taste* and *odour*. When dropped on sugar, the purest part of the oil is rendered soluble in water. This union is termed an *Oleo-saccharum*. They are soluble in alcohol, but not all in the same degree: thus, oil of Turpentine, when mixed with alcohol, separates by rest. They are, also, soluble in ether, in every proportion, and in fixed oils.

Volatile Oils unite very imperfectly with alkalies and other oxides, forming a species of soapy compound, which the French chemists term *Savonules*. They are acted upon by the mineral acids, which change them into substances resembling resins. In these instances it is probable that the change is effected by the abstraction of oxygen from the acids. Nitric acid reddens some of the medicinal Volatile Oils; for instance, oil of Cloves and of Sassafras; on all of them the strong

* M. Brandes ascertained the specific gravity of thirty-one of the light kinds, and found the range to be between 0.8520 and 0.9725.—*Archiv* 21, 1827.

acids act powerfully, sometimes producing combustion : both oil and acid are decomposed, and carbonic acid, azote, the oxide of azote, sulphurous acid, and aqueous vapour, are evolved, according to circumstances. With chlorine there is less action ; a heavy, white, concrete, oily substance is formed, and at the same time muriatic acid is produced ; from which I infer, that the oil loses an equivalent of hydrogen, which alters its characters and assimilates it to the concrete essential oils, whilst the hydrogen, combining with the chlorine, converts it into muriatic acid. This fact has not yet attracted the attention of chemists. Iodine, when mingled with some of them, causes heat sufficient to evaporate the Iodine : with others no such effect is produced : most of them dissolve Iodine. Some of them readily dissolve sulphur, forming a deep brown-coloured liquid, termed *Balsam of Sulphur*.

When exposed to the atmosphere, at the temperature of from 32° to 212° Fahrenheit, the Volatile Oils yield part of their carbon and hydrogen to the oxygen of the air, thicken, and acquire the properties of varnishes : when the temperature is high, they take fire, and burn with a bright flame and black smoke, forming much carbonaceous matter, carbonic acid and water.

Volatile Oils are frequently adulterated with alcohol and with fixed oil. Alcohol is detected by agitating the suspected oil with water : if it be present, the water will become milky, and retain the odour of the volatile oil. Fixed oil is detected by dropping a little of the oil on clean paper, and warming the paper : if the oil be adulterated with fixed oil, a greasy spot is left on the paper ; if it be pure, the whole of the oil evaporates, leaving the paper clean.

Such are the general physical and chemical properties of the Volatile Oils. In noticing their general effects as medicinal agents, a very brief examination of those arranged, as Excitants, under the head *uncombined*, will suffice.

By uncombined Volatile Oils is understood those which are lodged in cells, or vesicular receptacles in the plants, uncombined with other vegetable principles.

The volatile oils of Caraway, Anise, and Dill seeds, are ob-

tained from the seeds of *Carum Carvi*, *Pimpinella Anisum*, and *Anethum graveolens*, plants belonging to the natural Order Umbelliferae. In these seeds the oil is secreted in the upper part of the fruit, whence it descends through canals, marked by longitudinal furrows on the seed, and is deposited at the lower part, either in these tubes or in enlarged cells. The oil of Anise crystallizes at 50° Fahrenheit, in flat plates*; its ultimate components are 76.487 parts of Carbon, 9.352 of Hydrogen, 13.821 of Oxygen, and 0.460 of Nitrogen†. These three oils are lighter than water. The seeds yielding these oils are frequently employed in powder, as cardiacs, to expel flatulence; but the oils themselves, in the form of oleo-saccharum, are preferable to the seeds. They are useful adjuncts to correct the griping properties of some drastic cathartic pills.

The seeds of Fennel, *Anethum Fœniculum*, another Umbelliferous plant, and the distilled oil obtained from them, are both in use as Excitants. The Fennel is a biennial plant, which grows chiefly in stony places in most parts of Europe and in Hindostan. The seeds are smooth, ovoid, striated longitudinally; they have an acrid, somewhat sweetish taste, and an unpleasant odour; qualities depending on the volatile oil they contain. The oil is nearly colourless, has a hot, sweetish taste, and does not congeal until the temperature exceeds 50° below zero. Its specific gravity is 997‡. It is rarely used, except in the form of the distilled water. The seeds enter into several officinal preparations.

Cajuputi oil is obtained from the leaves of the *Melaleuca cajuputi*, an elegant tree, a native of the Molucca islands: it is a member of the natural order Myrtaceae. This oil is deposited in minute cells in the leaves, which are alternate, narrowly lanceolate, and, while young, sericeous§. On being

* In the chemical action of these oils on the mineral acids, the oil of Caraway differs from the other two in acting most violently on sulphurous acid; both the oil and the acid are decomposed, and much sulphurous acid evolved.

† M. de Saussure.

‡ Lewis.

§ See Woodville's Med. Bot. 3d edit. vol. v, p. 57, pl. 15. Rumphius' Herb. Amboin. vol. ii, t. 17. London Dispensatory, art. *Melaleuca*.

bruised the leaves smell strongly of the oil, which is prepared from them by distillation, after they are dried.

Cajuputi oil is limpid, and of a beautiful bluish-green colour: its odour is powerful, resembling a mixture of turpentine, camphor, benzoic acid, and cloves: its taste pungent and aromatic. Its purity is ascertained by dropping it on the surface of water, over which the pure oil rapidly diffuses itself, and completely evaporates. It dissolves readily in alcohol, burns rapidly when ignited, and leaves no residue. It dissolves Iodine, is decomposed by sulphuric acid; but it requires the aid of heat for its action on nitric acid. The colour is no test of its purity, as the pure rectified oil in India is colourless.

This oil is a powerful Excitant; when taken into the stomach, it causes a glow, fills the pulse, and excites greatly the nervous system; and, from determining to the surface, and equallizing the circulation, it has been lately much prescribed in malignant cholera. The dose for internal use is from m. iii to m. vi. rubbed up with sugar as an oleo-saccharum. As an external Excitant, I have found Cajuputi oil useful in Phlegmasia dolens: after the active inflammation, which is probably of a rheumatic kind, is subdued, this oil, diluted with four parts of olive oil, forms a valuable embrocation.

In the natural order Aurantiaceæ, we find two medicinal volatile oils deposited in vesicles on the exterior rind of the Orange, *Citrus aurantium**, and that of the Lemon, *Citrus medica*†. These oils have a pale straw-colour, an agreeable odour, and a pungent acrid taste. They dissolve Iodine readily, forming a deep reddish-brown compound. The oil of Orange-peel scarcely acts upon nitric acid, the oil of Lemon-peel not at all. With muriatic acid, both form a kind of paste, made up of white lamellar scales, and a yellow fluid oil: freed from the latter, the crystals sink in water, dissolve in alcohol, and sublime when heated in close tubes; thus resembling, in many respects, the artificial camphor produced

* Woodville's Med. Bot. 3d edit. p. 523, pl. 188. London Dispensatory, art. Citrus.

† Woodville, p. 528; pl. 187.

by the action of muriatic acid on oil of turpentine. The ultimate components of oil of Lemons are 88.899 of Carbon, 12.326 of Hydrogen, and 0.775 of Nitrogen*.

Neither of these oils is much employed as Excitants.

The Order Rutaceæ presents us with only one volatile uncombined oil that can be regarded as belonging to this class, the *Oil of Rue*, a secretion of *Ruta graveolens*†, an indigenous plant. Although this oil is deposited in a pure state in distinct cells in the leaves and the flowers of the plant, yet, it also pervades every part of the plant, probably in a state of combination with resin. The Oil of Rue has a strong, unpleasant odour, and a hot, biting taste. The colour of the fresh-drawn oil is pale greenish-yellow; but this deepens by age; and a deposit resembling resin gradually takes place, without, however, injuring the properties of the oil. This oil dissolves Iodine readily, and is rapidly decomposed by sulphuric acid; but its action on nitric acid is very feeble. It congeals at 40° Fahrenheit.

The whole of the plant of Rue is employed on the Continent as an Excitant, in the forms of powder, decoction, and extract: but the oil is generally used in this country; and, when triturated with mucilage, or with sugar as an oleo-saccharum, it is preferable to the plant. In the form of oleo-saccharum, it may be administered in doses of from m. ii to m. v, at moderate intervals. The Edinburgh and Dublin Pharmacopœias contain an aqueous extract; but, as the oil is dissipated during its preparation, it possesses no excitant properties: it is an injudicious form for a medicine whose properties depend on volatile oil.

Oil of Rue excites powerfully the whole of the nervous system. The plant itself is extremely acrid in the fresh state; it was prescribed by Hippocrates, after being dried, in chlorosis and other diseases of females connected with a low state of the nervous energy; and it was equally prized by Boerhaave in the Neuroses: but it requires to be cautiously administered

* M. de Saussure.

† Woodville, p. 487, pl. 184. London Dispensatory, art. Ruta.

to pregnant women. In the present day, the oil is more employed as an Antispasmodic than as an Excitant. It has been externally applied as a Rubefacient in palsy.

The Order Labiatae contains more plants secreting uncombined oil than any other order. All the parts of these plants are studded with vesicular glands filled with volatile oil. The quantity formed by the plants depends much on the state of the atmosphere: when the air is dry and the temperature considerable, the secretion proceeds with great activity; when it is moist and the season wet, the quantity of oil is much diminished. Thence, within the tropics, the Labiatae yield not only Volatile Oil of a better kind, but also in greater quantity than those in the temperate zones. The oils afforded by this natural order deposite more Camphor than any of the other volatile oils.

When the Labiated plants are carefully dried, and the vesicles not ruptured, the plants retain all their properties in perfection; in fact, they become more active from losing their moisture.

The first of these oils which we have to notice is *Oil of Lavender*, the product of the *Lavandula spica**. The odour of this oil is most agreeable; the taste, like that of all volatile oils, is hot and biting. When newly distilled, it is nearly colourless, but gradually acquires a lemon-yellow hue: it dissolves Iodine rapidly; the solution being accompanied with a perceptible increase of temperature, and slight explosions. Sulphuric acid decomposes it instantly; but the nitric does not act upon it for some time, unless mixed with the sulphuric; in which case the action is violent. From these facts, the impropriety of ordering Tincture of Lavender in combination with diluted sulphuric acid, in the form of drops, is obvious. This oil dissolves in concentrated acetic acid; but it separates again when the solution is diluted with water. Its ultimate components are 75.50 of carbon, 11.07 of hydrogen, 13.07 of oxygen, and 0.36 of nitrogen†.

* Woodville's Med. Botany, third ed. p. 221, plate 114. London Dispensatory, art. Lavandula.

† M. De Saussure.

This oil is a powerful and frequently-employed Excitant. It is administered both in the form of oleo-saccharum, and in combinations with spirit, in the simple and compound spirits of Lavender of the British Pharmacopœias: its stimulant power was also formerly taken advantage of as a local stimulant in cephalalgia; the powdered flowers being used as an Errhine. They still form an ingredient of the compound powder of Asarabacca of the Edinburgh and Dublin Colleges.

Three species of the Genus *Mentha* yield volatile oil employed as Excitants: the *Piperita*, *Viridis*, and *Pulegium**. All the plants of this Genus so closely resemble one another, that it is difficult to distinguish them, unless we have recourse to the characteristics pointed out by the late Sir E. Smith: the hairs on the pedicils, and those of the bractes and the sepales. Thus, Spear Mint, *Mentha viridis*, besides being distinguished by the uninterrupted floral spikes, has the bractes and calycinal teeth furnished with stiff hairs, or setæ. In the Peppermint, *Mentha piperita*, the spikes are obtuse, and interrupted in the lower part; but the chief characteristic is the smooth, naked calyx, the teeth only being furnished with dark purple hairs; while, in the Penny Royal, *Mentha Pulegium*, the pedicils and the sepales are every where covered with down. These three species yield, by distillation with water, a considerable quantity of volatile oil†. They differ very little from one another, either in their physical or chemical properties, or in their effects on the animal œconomy: consequently, they may be indiscriminately used. They are of a pale yellow colour, lighter than water, have a penetrating odour, and leave on the palate an agreeable sensation of coolness, which is peculiarly striking in the oil of Peppermint. The plants yield most oil when cut in dry weather. They are all ready solvents of Iodine, and are decomposed by, and decompose, both sulphuric and nitric acids. M. Dublanc, by exposing oil of Peppermint to a temperature of 8° to 12° below 0, centigrade, obtained crystals of a tetrahedral form, which

* Woodville, pp. 336, 338, 342. Dispensatory, art. *Mentha*.

† The English oil of Peppermint is preferred even on the Continent.

separated and left a thin fluid oil. These crystals are soluble in alcohol and ether, and impress an acrid, rancid taste on the palate. Aqueous infusions of the plants, and water distilled from them, are employed in anorexia and weakened states of the digestive organs; and occasionally the plants themselves are used in the state of powder. These oils, rubbed up with sugar, or with mucilage, may be advantageously administered in doses of from m. i to m. iv, in cases of cramp of the stomach, flatulent colic, and other conditions of the digestive organ depending on a weakened state of its nerves. The pharmaceutical preparations of the plants are infusions, distilled waters, and spirits; the medicinal properties of all of which depend on the presence of the volatile oil of the plant in them.

In the same Order, the *Origanum vulgare* and *marjorana** both yield, by distillation with water, volatile oils. They are too hot and acrid for administration as internal Excitants; have a reddish yellow colour, and an acrid, bitter taste. Both of them dissolve Iodine rapidly, and are instantaneously decomposed by sulphuric acid, which itself suffers decomposition, and much sulphurous acid is evolved. Both act also upon nitric acid with violence, but not until they have remained for half a minute or more in mixture and assumed a dark colour. In the oils which have been long kept, white diaphanous crystals are deposited. The oils of Majoram are chiefly used as local stimulants in toothache, rheumatism, and other diseases attended with pain.

A very powerful uncombined volatile oil, employed as an officinal Excitant, is *Oil of Rosemary*, the product of the *Rosmarinus officinalis*†, which is chiefly deposited in vesicular cells in the petals of the flower. This oil, which is so acrid that it is seldom prescribed for internal use, has a penetrating, unpleasant odour, and differs in its chemical properties from other volatile oils, by the slight influence which it exerts

* Woodville's Med. Bot. third ed. p. 344, pl. 123, 124. London Dispensatory, art. *Origanum*.

† Woodville's Med. Bot. 3d ed. p. 329, pl. 117. London Dispensatory, art. *Rosmarinus*.

upon the sulphuric and nitric acids. When kept for some time, it deposits much Camphor. The ultimate components of this oil are 82.81 of Carbon, 9.42 of Hydrogen, 7.73 of oxygen, and 0.64 of Nitrogen. It is often adulterated with oil of Turpentine. The plant itself is employed in substance in the composition of cephalic snuffs. On the continent, an infusion of it is administered to awaken appetite and augment the digestive powers of the stomach. The dose of the volatile oil, if internally employed, should not exceed six minims. The best form of administration is that of an oleo-saccharum.

All these Volatile Oils operate as direct Excitants, in as much as their primary influence is exerted on the stomach; but, in almost every instance, the effect produced is extended by the nerves to the whole system. Volatile oils, however, are also taken into the circulation, and, pervading the system, shew themselves in some one or more of the excretions.

As I have already stated, in noticing the oil of Rue, the medicinal use of Volatile Oils is of very ancient date; for, although they were not obtained by distillation in the time of the Coan sage, yet, they were procured by the trituration of the plants and flowers yielding them with fixed oil, although in a very diluted state. From their antiseptic qualities and agreeable odour, in many instances, they were early employed in embalming the dead and for the preservation of animal matter from putrefaction.

Applied to the living system, Volatile Oil is powerfully stimulant: even on the surface, the application of volatile oil produces local inflammation. When taken into the stomach, the primary effect is that of a powerful Excitant acting directly on the nervous system of the viscus, and causing an excitement which is propagated over the whole system. When, therefore, the dose is large, the inflammation on the stomach is intense; and it may be followed by gangrene and death; but, when it is small, and its acrimony sheathed by other substances, as occurs in plants and vegetable products containing volatile oil, the stimulus is beneficial; promoting digestion and giving vigour to the habit, partly through the medium of the stomach, partly by being absorbed into the blood, exciting the action of the heart and arteries, and

thence promoting the excretions of the skin and kidneys. Although they are all more or less general Excitants, yet their action in some instances is chiefly exerted upon particular organs. Thus, the oil of Juniper will be found among the Diuretics, and that of Savine among the Emmenagogues.

Volatile oil is often the active principle of vegetable medicines; but, it is so variously combined, that it is frequently difficult to determine what share it possesses in the stimulant property of the remedy. In its uncombined and separated state, it is so powerfully stimulant, that it is never administered in its simple form, or undiluted with mucilage or some substance which can sheath its acrimony. Besides being employed as Excitants, they are much used to correct the griping property of resinous cathartics; for, although they afford a fresh stimulus, yet it subdues that state of the nerves on which the griping property of the resins act. In languid and sinking states of the system—such, for example, as the collapse in malignant cholera—Volatile Oil may be advantageously administered in the simple form of oleo-saccharum. In ordinary cases, it should be always sheathed with bland emulsions.

The more acrid of the Volatile Oils are employed externally as embrocations in paralytic affections and deep-seated pains. Toothache is often relieved by a drop or two on cotton being introduced into the hollow tooth.

Having examined the medicinal volatile oils which are found in an isolated, uncombined, or pure state in plants, we have next to enquire into the nature of those which exist in plants in combination with other principles. The natural combinations of volatile oils are with gum, fecula, extractive, resin, fixed oils, and a few other principles peculiar to certain plants. In these combinations, volatile oils are found forming the active medicinal agent of roots, wood, bark, flowers, and fruit.

** Roots and their Appendages.*

SERPENTARIA ROOT. *Serpentaria Radix.* L. E. D.—
This root owes its Excitant properties to volatile oil in

combination with gum-resin, bitter extractive, and a large proportion of fecula, which, indeed, forms the greatest part of the caudex ; and consequently this part is much less active than the radicles which are attached to it, and ought to be rejected. Each root consists of this caudex, which is a small gibbous body, from which numerous small fibrous radicles proceed, of a brownish colour in their dried state. As imported, the roots of the *Serpentaria* are sometimes mingled with those of the *Asarum virginicum*, which are readily distinguished by their black colour and defect of aromatic odour.

Serpentaria is the root of *Aristolochia Serpentaria**, a low, slender, perennial plant, a native of North America, particularly of Carolina and Virginia. The plant seldom rises more than eight or ten inches in height: the stem is slender and flexuous, furnished with alternate, heart-shaped, acuminate, entire leaves, slightly ciliated. The flowers are small, of a purple colour, and situated on long pedicils at the lower part of the stem, distant from the leaves†.

This little plant is generally found growing in thick woods and on the shady sides of mountains from New England to Carolina. The dried roots are imported to Europe in bales.

Snake-root has an odour somewhat aromatic, resembling that of camphor : and a warm, bitter, pungent, terebinthinate taste, not easily concealed by any admixture. It owes its odour to an essential oil, which rises in the distillation of the root with water ; its bitterness, to a bitter principle closely resembling that of quassia in its chemical properties, at least as far as can be determined by tests : subacetate of lead and nitrate of silver being the only substances which precipitate the infusion, The alcoholic tincture is rendered turbid by the addition of water.

Serpentaria has been examined by Chevalier and by

* The genus *Aristolochia* contains species with flowers of the greatest diversity in point of size. One species, growing on the borders of Madalena, is so large that they serve as bonnets for children.

† Barton's Veg. Mat. Med. of the United States, plate 28, page 41. Woodville's Med. Bot. third edition, p. 153, fig. bad. London Dispensatory, art. *Aristolochia*.

Bucholz. According to the latter, it consists, of volatile oil 0.05, greenish-yellow resin 2.85, bitter extractive 1.07, gummy extract 18.01, ligneous fibre 64.04, water 14.45. It also contains a free acid, the nature of which I have not determined.

This root was first brought into notice in Europe in 1635, by a pamphlet, published in Paris by Dr. J. Cornutus, recommending it as an effectual remedy for the bites of snakes; thence its specific name, *Serpentaria*. The generic name is derived from two Greek words, *αριστος* and *λοχια*, from some supposed use of several of the species in cleansing the lochia after parturition; and thence, also, the English name *Birthwort*.

It is a powerful Excitant, peculiarly suited to cases of both remittent and malignant fever, when the powers of life are languishing, and, yet, the skin is hot and dry. If the surface be kept warm, it rarely fails to excite the action of the capillaries of the skin. In the low stage of typhus, it is commonly combined with Camphor and Peruvian bark: it generally determines to the surface, at the same time that it supports the powers of life. I have given it in cases of protracted intermittents, especially when these have been combined with cough; and it has removed the disease after sulphate of quinia and arsenic had failed.

In dyspeptic affections, also, where there is a very languid circulation, and in which the skin is dry and harsh, the *Serpentaria* has been found useful, not only in relieving this condition of the skin, but in supporting and supplying energy to the general habit. In cases of pustular eruptive fever, when there is a receding of the eruption, as occasionally occurs in confluent smallpox, *Serpentaria* tends to support the action of the skin, and, consequently, to fill and keep out the pustules.

From its stimulant nature, it is contraindicated in states of the habit requiring the use of the lancet. The form of preparation commonly employed is infusion, made of various strength according to circumstances: perhaps the best proportions are ℥i of the bruised root to f℥xii of water. Of this infusion f℥iiss may be given for a dose.

Another species of *Aristolochia*, the *A. rotunda*, was an

ingredient in the celebrated Portland powders, an obsolete remedy for the gout, which Parliament bought from the proprietor. Cullen affirms that this species of *Aristolochia* has the power of preventing attacks of gout when it is taken daily for some time: but that it causes dyspepsia and hypocondriasis!

As a local Excitant, *Serpentaria* has, also, been found useful in gangrenous sores; and in the form of a gargle in ulcerated throats, in which case I have generally combined it with tincture of capsicum.

ROOT OF SWEET-FLAG. *Radix Calami*. L. *Acori Calami radix*. E.—Syn. *Calamus Aromaticus*.—This substance is improperly termed a root in the Pharmacopœias; it is a *rhizome*, or descending part of the stem, emitting roots or radicles. This rhizome or caudex is the active part: in it volatile oil is combined with fecula, inulin*, and gum. The plant to which this rhizome belongs, the *Acorus Calamus*, is an indigenous aquatic, arranged in the natural order Aroideæ†. It is found in many parts of Europe, in India, and Japan; and grows abundantly in shallow pools and on the banks of rivers in England. The rhizome is about half an inch to an inch in thickness, flat, jointed, and of various lengths. The joints are nearly an inch in length, and send off from their lower surface whitish-yellow rootlets, and also from the upper part bunches of brown, hair-like fibres, when the plant has grown in its natural marshy situation. The leaves of the plant, which are ensiform and waved on one margin, are, when bruised, as aromatic as the rhizomes.

The dried rhizome is covered with a corrugated cuticle, of a brownish-yellow colour, marked with many white elevated spots on the under side whence the radicle fibres issue. It breaks with a hackly fracture, displaying a pale bluish-white

* This principle has much resemblance to starch; from which, however, it is distinguished by being deposited as its solution in hot water cools, and in striking with Iodine a greenish-yellow instead of a blue colour. It is distinguished from gum by its insolubility in cold water, and by not yielding saccholactic acid when digested in nitric acid.

† Barton's Veg. Mat. Med. vol. ii, plate 30, p. 66. Woodville's Med. Bot. vol. iv, pl. 248, p. 725, 3d edit. London Dispensatory, art. *Acorus*.

interior, tinged on the outer part with shades of rose-red and bistre; it exhales an agreeable aromatic odour, and has a warm pungent taste, not unlike that of camphor, becoming bitter and nauseous when much chewed. The smell and taste are improved by drying. The aromatic principle is an essential oil, which can be separated by distillation.

This oil differs from most of the other volatile oils in some particulars: it does not dissolve iodine; it instantly decomposes sulphuric acid, but it is slowly acted upon by the nitric. It is lighter than water, of a pale yellow colour, and possesses the odour and pungency of the plant in an eminent degree: it is combined with fecula, as well as inulin, which are indicated, in the decoction, by Iodine* and subacetate of lead; not, as Tromsdorff states, with a viscid resin and mucus. When alcohol is digested on the pulverized rhizome, a resinous extract is procured on evaporating the tincture.

It has been doubted whether this be the *Calamus Aromaticus* of Dioscorides, although, from the abundance of the plant† in Greece and Syria, there is much probability that it is the same plant.

The Rhizome of *Acorus Calamus* is an excellent Excitant in colic, in the flatulence of dyspepsia, and in the low sinking stage of malignant fevers; and, from my own experience, I know that it is one of the best additions to bark and sulphate of quinia in intermittents. It has been used alone, successfully, in Norfolk in curing intermittents. It is an excellent medicine in those cases of dyspepsia in which vertigo, arising from flatulence, is one of the symptoms: but, like many other valuable

* According to the analysis of Tromsdorff, 64 ounces of the fresh rhizome yielded of volatile oil gr. 15, inulin ℥i, extractive matter ℥ix, gum ℥iii, viscid resin ℥iss, ligneous matter ℥xiii ℥vi, water ℥xvii. *Annales de Chimie*, tome 18. Mr. Gray, a chemist in Bond Street, has lately distilled this oil: he procured 29oz. from 7cwt. 23lbs. of the rhizomes.

† Dr. Duncan has investigated this subject, and has detailed the results of his inquiries in his Supplement to the Edinburgh new Dispensatory. They display considerable learning and patient research, but are by no means satisfactory; and, after all, it is a subject more curious than useful. The ancient *Calamus* was an ingredient of the Mithridate and Theriaca: the modern formed part of the Elixir Vitæ of Mathiolus.

native remedies, it is much neglected. Dr. Paris mentions that it is so favourite a remedy with the native practitioners of India, in bowel complaints, that a penalty is incurred by any druggist who refuses, in the middle of the night, to open his door and to sell the *Acorus*-root, if demanded. This is true: but the Indian *Acorus* is not our plant: it is a variety which Willdenow has described under the name *Acorus verus*; and which is also a native of Flanders, Poland, and Tartary.

Calamus aromaticus is most advantageously given in substance, in the form of powder. Infusion does not impair its properties; but decoction destroys them, by dissipating the volatile oil. The dose of the powder is from $\mathfrak{z}\text{i}$ to $\mathfrak{z}\text{ij}$. It is usefully combined with magnesia and chalk, in the flatulent colic of Infants.

GINGER. *Radix Zingiberis*. L. E. D.—This substance is another rhizome, which contains volatile oil combined with fecula. It is a tuber or reservoir of nutriment for future plants. The Ginger plant, *Zingiber officinale*, is arranged in the natural order Scitamineæ: an order characterized by the rhizomes of the plants containing aromatic principles.

The Ginger plant is a native of the mountains of Gingi, in Hindostan, whence its name is derived. It was carried from India to Cayenne and to the West Indies, where the greater part of the Ginger used in Europe is cultivated.

The tubers or rhizomes, the parts medicinally employed, are attached to the base of the plant. They are perennial, palmated or knotted, flat, fleshy, and greenish within, but becoming fibrous and pale yellow with age; they are covered with a wrinkled purplish epidermis, and marked with scarcely perceptible circles*. In the dry state, *White* Ginger is nearly white on the exterior, long, and more or less knotted; it breaks with a fibrous fracture, and has a whitish-yellow tinge within. The *Black*, or common Ginger, is in shorter pieces, and covered with a cuticle of a dirty grey colour.

* For the botanical characters of the plant, see Woodville's *Med. Bot.* p. 731, pl. 250, 3d edit. Jacquin *Hort. Vindob.* vol. i, t. 76; and for the method of preparing the Ginger, see *London Dispensatory*, art. *Zingiber*.

As the tubers are undoubtedly repositories of nutriment for future plants, it is probable that the acrid principle which they contain is intended to guard the fecula from the attacks of worms. The Ginger is dug up in January, after the stems, which are annual, have withered: the best pieces are selected, scraped, separately washed, and dried in the sun, for what is termed *white ginger*: but, when they are simply scalded before being dried, they are then called *black Ginger*. The difference consists in the selection of the tubers for the preparation of the white Ginger, which is higher flavoured and more pungent than the black Ginger. Soundness, or freedom from worm-holes, compactness and weight, constitute the goodness of both kinds.

Ginger, in the state in which it is imported, has an aromatic, pungent odour, and a hot, biting, acrid taste. Alcohol and ether extract its efficient principle, which is a volatile oil lighter than water; and which, besides its union with the fecula that constitutes the greater part of the Ginger, is combined with resin. This oleo-resin can be obtained by distilling the alcoholic tincture of Ginger; the residue is this substance.

The volatile oil, which is of a bluish-green colour, is obtained in small quantities by distilling the bruised tubers with a sufficiency of water to prevent empyreuma. When the oil and resin are removed, the fecula can be obtained in a nearly insipid state by washing the residue in the manner for obtaining starch from wheat-flour*.

According to the analysis of M. Morin, Ginger contains—

1. A resinous matter—soluble in Ether;
2. A sub-resin—insoluble in Ether;
3. A bluish-green volatile oil—lighter than water, and extremely acrid;
4. Free acetic acid;
5. Acetate of Potassa;
6. Osmazome;
7. Gum;
8. A vegeto-animal matter and mineral salts;

* M. Planché says the starch is as pure and bland as that obtained from wheat.

9. A large proportion of fecula, some sulphur, oxides, and lignine*.

Ginger acts powerfully upon the mucous membrane in whatever manner it is applied to it; a fact, evident from its sternutatory properties, and well known to horse-jockeys, who introduce it into the anus of the horse, to make him erect the tail and appear more agile than he really is, when on trial for sale. It also acts on the salivary glands, causing an abundant flow of saliva. In a moderate dose, Ginger is an useful general Excitant in flatulent colic, dyspepsia, and gout in the stomach; but it requires to be employed with caution, particularly by those who have any tendency to stricture of the urethra, as it excites the genital organs. It rouses, generally, the nervous energy; but I cannot accord with those who assert that it improves the sight, strengthens the memory, and elevates the moral faculties.

Ginger is a useful addition to griping purgatives, rendering them both agreeable and less likely to irritate the intestinal canal: it also appears to rouse the vitality of the intestinal surface, and to render it more susceptible of the influence of cathartic substances. The dose of Ginger, in the form of powder, is from gr. x to ʒi: but, from habit, much greater quantities are daily taken as a condiment. It forms one of the numerous ingredients of the ancient Mithridate; and enters into many modern officinal preparations.

TURMERIC. *Curcumæ longæ Radix.* D.—The tubers of *Curcuma longa* are also rhizomes, which owe any medicinal properties they possess to the combination of a volatile oil with fecula. The plant which yields them is a native of India, and extensively cultivated there. It is arranged in the same natural order as the Ginger. The rhizomes are tuberose, oblong, whitish, knotted, and about the thickness of the finger, with some fleshy fibres attached to the nodes†.

* Journ. de Pharm. Juin. 1823.

† For a botanical description of the plant, see Woodville's Med. Bot. p. 737, t. 252, 3d edition. Jacquin Hort. Vindob. tome 3, p. 5, tab. 4. London Dispensatory, art. Curcuma.

The odour of the Curcuma root is not unlike that of ginger; its taste is acrid, aromatic, and a little bitter. The tubers are cylindrical, oblong, about the size of a pigeon's egg, tuberculated, rugose, and heavy: they break with a waxy fracture, and display internally a deep yellow colour marked with shining points. According to an analysis of Vogel, Pelletier, and Caventou, they consist of—

1. A brown colouring matter, resembling extractive;
2. a small quantity of Gum;
3. an odorous, very acrid volatile oil;
4. a yellow colouring matter;
5. some Hydro-chlorate of Lime;
6. Fecula and Lignine*.

The dried rhizomes are brownish, externally wrinkled, of a golden-yellow or saffron colour, and in taste and odour not unlike ginger; they tinge the saliva yellow. The yellow colouring matter resembles resin; when pulverized it is heavier than water, in which it is sparingly soluble; it is very soluble in alcohol, in ether, and in both fixed and volatile oils: the alkalies deepen it to a dark red-brown; thence paper, tinted with Turmeric, is used as a test of the presence of alkalies. On account of this yellow colour, it was supposed by the ancients to be a remedy for Jaundice.

Turmeric was at one time employed as a stimulant to the uterus, in defective or obstructed menstruation; but its use has now become almost obsolete.

As an Excitant, it sharpens the appetite, and aids the digestive process; and its stimulant powers, extended to the system, quicken the pulse and elevate the temperature of the body.

* * Woods.

SASSAFRAS. *Sassafras Lignum et radix.* L. E. *Oleum*

* Journ. de Pharm. 1826, p. 289. John also analysed Curcuma, and obtained—a volatile oil, 1 part; yellow resin, 11 parts; yellow extractive, 12; gum, 14; lignine mixed with a matter soluble in potassa, 57; water, 5; = 100.

Volatile. D.—Sassafras is the only wood in the list of Excitants. It is the wood of the *Laurus Sassafras*, one of those plants in which the volatile oil, to which it owes its medicinal properties, is so abundantly secreted as to render the roots, the wood, and the bark officinal. It is arranged in the order Laurineæ, the most elegant of the natural orders.

This plant is a native of North and South America. It was discovered by the Spaniards after their conquest of Florida, under Ferdinand de Soto, in 1538*. It is a handsome tree, rising about forty feet in height, with large, alternate, caducous leaves, varying in form, some oval, nearly obtuse, narrowed at the base, entire, and with reticulated nerves; others trilobed, almost cordiform, with two or three longitudinal nerves†. The wood is imported in junks of different sizes, in general about the thickness of the arm of a man, covered with a rust-coloured, spongy bark, which is more aromatic than the wood; but the wood of the root is more so than that of the stem: all three have a powerful odour not unlike that of Fennel, and an aromatic, sweetish, slightly acrid taste. The wood has a brownish-yellow colour veined with brown. The volatile oil on which the odour and medical properties of these parts depend can be separated by distillation: it is colourless when newly drawn, but acquires a deep yellow, almost red colour by age. It is heavier than water, and is so abundant that six pounds of the rasped wood yield two ounces of the oil. Boiling water extracts partially the properties of the bark and wood of Sassafras; alcohol completely; and, by distilling off the spirit, an oleo-resinous extract remains, possessing all the active virtues of the Sassafras.

As a medicinal agent, Sassafras and its preparations operate as Excitants. Its exciting power seems to be exerted chiefly on the capillaries, and to cause sweating or a flow of urine, according as the surface is kept warm or cool. When

* Savary's Dictionary, vol. ii, p. 487. The Spaniards called it Cinnamon tree; the Indians Pavamé. The name Sassafras was imposed by the French.

† For the botanical characters, see Woodville's Medical Botany, p. 674, pl. 234, 3d edit. London Dispensatory, art. Laurus.

the skin fails to be affected, it excites febrile symptoms. At one time the bark and the wood were highly extolled, and, whether given in the form of infusion or in any other form, were regarded as a specific in rheumatism and gout. Its fame was also great as an antisymphilitic. To those who may still wish to try its effects in syphilis, it should be known that bichloride of mercury is incompatible with the infusion which it precipitates; neither can the infusion be given in combination with salts of iron. But, although Sassafras and its preparations are certainly Excitants of some power, stimulating the capillaries and invigorating the general habit, yet, they have fallen into disrepute, and are now employed almost solely as domestic medicines, in acné and similar cutaneous eruptions—a relic of the humoral school, the sole remnant of the doctrine of sweatening the blood.

* * * *Barks.*

CINNAMON* BARK, OIL OF CINNAMON. *Cinnamomi Cortex*;—*Oleum*. L. E. D.—Few Excitants of a vegetable origin, which owe their remedial powers to volatile oil, possess the importance of Cinnamon bark, in a national or commercial and even in a medicinal point of view. The tree, *Laurus Cinnamomum*, which yields it and Cassia, its congenerous Excitant, belongs to the order Laurineæ. It is a native of Ceylon and of several other oriental countries, as China, Cochin China, Java, Sumatra, Malabar, and the Philippine Isles. It is also now cultivated in the Isles of France and Bourbon, the West Indies, at Cayenne, the Brazils, and some other parts of South America. But the best is that which is grown in Ceylon†.

* The name *Cinnamon*—κινναμωμον of the Greeks, *Kinamon* of the Hebrews—is supposed to be derived from *kayu-manis*, the Malay name of the tree.

† Some years ago, Mahommed Ali, Pacha of Egypt, introduced the cultivation of Cinnamon into his country. The original plants were three cuttings from the garden of M. Boursault, at Paris: they have been so well managed, that some Egyptian Cinnamon has already found its way into the European markets.

Dr. Martius, the distinguished Bavarian naturalist, sent me a specimen of

It is the inner bark of this tree, the *Laurus Cinnamomum**, which forms the Cinnamon and, as I shall afterwards explain, the officinal Cassia. This bark is freed from the epidermis before it is stripped from the branches, and afterwards from a green, pulpy matter under it: after which it contracts, dries and assumes the quilled form. The smaller pieces are put within the larger, and in this state it is exported. The acrimony of the recent bark is so great that it blisters the mouth. In sorting the Cinnamon, therefore, tasting, which was formerly resorted to, is now discontinued. The bark is examined piece by piece, and sorted into three parcels, the first, second, and third sort. That which is evidently taken from large branches is rejected, as well as that from very young twigs; the first because, in the elder branches, the aroma is sharp and not very agreeable; the second because the oil contained in very young branches is rapidly dissipated in the drying of the bark. These inferior specimens of Cinnamon are put into the still for the purpose of obtaining the oil; for, besides the preparation of the Cinnamon, the volatile oil is distilled in Ceylon.

There are four varieties of Cinnamon, known in commerce—*Ceylon*, *Chinese*, *Cayenne*, and *flat*. 1. *Ceylon* Cinnamon is the best. It is in long pieces, very thin, scarcely thicker than paper, and one piece is slipped within another. It has a citron-fawn colour, an aromatic odour, and an agreeable, hot, slightly biting, sweetish taste, without leaving any nauseous or bitter impression on the palate. It yields, in distillation, a small quantity of a highly acrid, heavy, volatile oil which has the odour and taste of the Cinnamon in a concentrated state. This oil is stated to be deposited in particular cells in the interior of the bark, or that part which is next to the wood in the living plant. It is of greater specific gravity than water. When the Cinnamon is devoid of sweetness, and leaves a mawkish

Brazilian Cinnamon: it is, in every respect, inferior to the worst of the Oriental Cinnamon.

* For an accurate botanical description of the tree, see Woodville's *Med. Bot.* p. 670, pl. 233, third edition; and for an account of its varieties, cultivation, and mode of barking, see the *London Dispensatory*, art. *Laurus*.

taste in the mouth : it is of an inferior quality. 2. The *Chinese* Cinnamon is thicker than that of Ceylon, and of a higher colour : its odour is stronger ; the taste is more pungent ; it affords a larger quantity of volatile oil. This is the general distinction of the Ceylon and the Chinese Cinnamon ; but sometimes that of China is as thin and as good in every respect as the Ceylon*. 3. The *Cayenne* Cinnamon has the same characters as the Ceylon, but is thicker. A variety grown in the Brazils is much inferior. 4. *Flat* Cinnamon is taken from the larger branches and the trunk of the tree : it is much thicker than any of the other kinds, is much less quilled, slightly rugose, of a deeper yellow on the surface, and of a paler yellow within and glazed : its fracture is fibrous, and its odour and taste are very feeble.

Both alcohol and water extract the active principles of Cinnamon. Ether takes up scarcely any of the colouring matter ; but, when it is digested for some time on the powder of Cinnamon and evaporated, an oleo-resinous matter is obtained which tastes and smells like Cinnamon. The aqueous solution or infusion is precipitated by persulphate of iron, of an olive-green hue, demonstrating the presence of tannin, which is also displayed by gelatin : the acetate of lead discovers mucilage : iodine does not detect the presence of fecula. The infusion is also precipitated by lime-water and the carbonates of alkalies ; the precipitates, in this case, being compounds of the oxides or alkaline bases and the tannin. According to the analysis of Vauquelin, Cinnamon bark contains volatile oil, tannin, mucilage, a colouring substance of a vegeto-animal nature, an acid, and woody fibre†. It is to the volatile oil, and some *bitter resin* which Vauquelin has overlooked, that the active properties of the Cinnamon are to be ascribed. This oil can be obtained by simple distillation ; but it is more easily procured by distilling the

* Cinnamon is now also an article of trade from Borneo ; and some of a very fine quality is grown in the central mountains of Cochin-China.

† Journal de Pharmacie, Octobre 1827. M. Planché has obtained from it a crystalline matter similar to that which is supplied by cloves, and thence named *caryophylline*.

alcoholic tincture. The quantity yielded is extremely small, being less than a drachm from ℥xvi of the bark. It has a whitish-yellow colour, possesses a hot, biting taste, and a pungent odour, and is heavier than water. The water in which the oil is distilled remains highly charged with it: the volatile oil is also extracted by wine and alcohol.

As a medicinal agent, Cinnamon is a powerful Excitant, acting primarily on the stomach, causing a sensation of warmth in the epigastrium, and exciting the whole nervous system, which sympathises with the stomach and causes all the organs to exercise their functions with augmented energy. It was employed by the ancients, who knew it by the name *Kinnamomon*, a term which is supposed by the learned Scaliger to be derived from the Hebrew word *Kinamon*. The Greeks in particular were acquainted with it, and appear to have imported it both in the state of bark and also adhering to the wood. The younger branches with the bark on them they termed *Κυνναμωμον*, and sometimes *ξύλοκασία*: the bark, when separated and dried, and become tubular, they called *κασία συρίγξ*, or *Cassia fistula*. Theophrastus and Pliny mention a fabulous and absurd account of the method of separating the bark. They relate that it is cut into short pieces, and being sewed up in a fresh hide, which is allowed to putrefy, the worms eat the wood and leave the bark.

Galen mentions several kinds of Cinnamon, as importations to Rome in his time. Among other things, he mentions a bow, which was brought to Rome, four cubits and a half long, made of the best kind of Cinnamon: thence it appears that it was not barked. Celsus notices its medicinal qualities, and recommends that it be given as a drink “*per potionem*.”

Cinnamon is scarcely ever employed alone as an Excitant; but it is generally added to bitter medicines that possess no aromatic principle, and for covering the taste of nauseous medicines. It cannot be prescribed with the yellow *Cinchona* bark, on account of the tannin which it contains; but it may be united with *Cascarilla*, *Quassia*, *Gentian*, and *Calumba*. The oil is a more energetic stimulant than the bark, and may be administered in the form of *oleo-saccharum*; in which state it may be given with advantage, in conjunction with any tonic

bitter, or alone, in cramp of the stomach, flatulent colics, malignant cholera, and gout suddenly attacking the stomach by metastasis. It is well adapted for checking those vomitings which attend some dyspeptic affections, apparently depending on a morbid condition of the spinal and ganglionic nerves, which this Excitant seems to change by the impression which they make on the sentient extremities of the gastric nerves. The tannin it contains in combination with the volatile oil admirably fits this bark for those cases of diarrhœa which, from the absence of all inflammation, seem to depend on direct debility of the intestinal canal. It is particularly adapted for the stage of collapse in malignant or Asiatic cholera. The powder contains all these properties, and may be given in doses of ℥ss to ℥i; or the oil to the extent of from m. iii to m. v, either united with water, by the medium of sugar, or mucilage or yolk of egg. This bark enters into several pharmaceutical preparations: a *distilled water*, which is an agreeable vehicle for many other medicines, but which, when long kept, becomes nearly inert, owing to the subsidence of the oil; a *spirit*, which is a mere solution of the oil in diluted alcohol; and two *tinctures*; one simple, containing the oil, tannin, and colouring matter of the bark; and the other a compound of various aromatics in conjunction with the oil and tannin of the Cinnamon in proof spirit. There is also a *compound powder of Cinnamon*, consisting of nearly the same ingredients as the tincture, independent of the alcohol. They are all good Excitants, and are given with advantages in cases attended with nervous languor; acting as cordials, diaphoretics, antispasmodics, or emmenagogues, according to circumstances. The oil is sometimes used locally in toothache, by being dropped upon cotton and inserted into the hollow of the decayed tooth. But Cinnamon is usually regarded rather as a useful adjunct to tonics and other medicines than as a direct Excitant.

Cassia was generally supposed to be the production of a distinct species of *Laurus*; and as such it is set down under the name *Laurus Cassia* in all the British Pharmacopœias. But Mr. Marshall, who, from his appointment as a staff surgeon to the forces in Ceylon, had excellent opportunities of

determining the fact, and who has published the best account of Cinnamon which has yet appeared, asserts that it is the bark of the same tree as that which yields the best Cinnamon. It is true that the *Laurus Cassia* grows in Ceylon; and there is a marked specific distinction in the ribbing of the foliage of the trees. In the *Laurus Cinnamomum* the leaves are strongly marked with three longitudinal nerves, which extend from the base to the apex of the leaves: in the *L. Cassia* these longitudinal nerves, or bundles of vessels, are also present; but they do not extend the whole length of the leaf; on the contrary, they are given off from the mid rib. The leaf of the *Cassia* is, also, waved on the margin; and it is less odorous than that of the true Cinnamon.

Mr. Marshall informs us that the *Cassia* is never barked, on account of the bitterness of its bark, which has, in some degree, the odour and taste of myrrh. The term *Cassia*, which was formerly used in Ceylon to specify the Cinnamon, is now employed only to designate the bark of the large branches of the *Laurus Cinnamomum*, or as a synonyme of *Coarse Cinnamon*. The worst kind of Cinnamon, that which is set aside for distillation in Ceylon, and, also, a Cinnamon imported from Cayenne, have been brought into this country and sold as *Cassia*. Some of the German writers still maintain that *Cassia* and Cinnamon are the barks of a distinct species; but the evidence of Mr. Marshall, who investigated the subject on the native soil of the trees, far outweighs the evidence of twenty naturalists who have not enjoyed similar opportunities of observation.

With respect to the barks, the sensible qualities of *Cassia* closely resemble those of Cinnamon: it, however, affords, when masticated, the idea of a slimy substance. The difference of these barks consists chiefly in the cellular tegument, which is left on the *Cassia*, but is removed from the Cinnamon. When this is scraped off, *Cassia* bark is in every respect the same as Cinnamon.

On the infusion of *Cassia*, chemical reagents display a different mode of action from that which they exert on the infusion of Cinnamon. Thus, in the infusion of *Cassia*, the solution of persulphate of iron throws down a greenish pre-

cipitate; iodine produces a decided blue tint; lime water throws down a copious light brown precipitate; and oxalate of ammonia a similar precipitate, an effect which must depend on the presence of some salt of lime, not formed in good Cinnamon bark. In the infusion of Cinnamon all the effects of reagents are the same as on that of Cassia, with the exception of the blue colour produced in the latter with iodine, and the precipitate with oxalate of ammonia. The salts of lead, iron, silver, bichloride of mercury, and lime water, are incompatible with infusions of Cinnamon and Cassia. It is a curious fact that a very striking difference exists in the action of nitric acid on the oils of Cinnamon and Cassia: the former is scarcely affected; the latter rapidly changes to a deep brown: alcohol added to the former merely dilutes; to the latter, it changes the solution to green.

The medicinal properties of Cassia are in every respect the same as those of Cinnamon. It may be given in the same doses, and in the same combinations. It is, however, less agreeable to the taste, owing to the cellular, exterior part of the bark, which is separated in good Cinnamon.

WINTER'S BARK. *Winteræ Aromaticæ Cortex*. E.—*Drymis Aromatica, Cortex*. D.—A valuable combination of volatile oil with resin is found in the bark of the *Drymis Aromatica*, or *Winteri*, the true Winter's Bark. The tree which yields this bark grows in the Straits of Magellan, where it was discovered by Captain Winter in 1577, and thence received his name*.

The true Winter's Bark is usually in slightly quilled pieces, about eight or ten inches in length, and from one to two inches in breadth, and not more than one fourth of an inch in thickness. It is wrinkled on the exterior, is of a reddish grey colour, and spotted with elliptical red blotches: interiorly, it is a dark brown Cinnamon-hue, sometimes nearly black. It breaks with a compact fracture, which is grey at the outside and red within; these two colours being separated by a very

* For the botanical characters of the tree, see Woodville's Med. Bot. p. 647, pl. 226. The London Dispensatory, art. *Wintera*. Medical Obs. and Inquiries, vol. v.

sensible line of demarcation. Its odour is fragrant; its taste acrid and burning.

As a medicine, Winter's bark is an excellent Excitant. Its medicinal properties depend on a volatile oil and a very acrid resin. Besides these two principles, M. Henry has discovered in it a colouring matter, tannin, the acetate, hydrochlorate, and sulphate of potassa, malate of lime, and oxide of iron. The oxide of iron and the tannin distinguish it from *Canella* bark, and are easily detected; the oxide by ferrocyanate of potassa, the tannin by persulphate of iron and gelatin. On account of the sulphate of potassa, the infusion is precipitated by salts of baryta.

Winter's bark imparts its properties to boiling water, and may be administered in the form of infusion. Decoction is a bad form of preparation. It is given also in the simple state in powder, in doses of from gr. viii to ℥i: on the Continent, a tincture of this bark is much employed. It acts as a simple but powerful Excitant, exerting its primary influence on the nerves of the stomach; but, like all the other vegetable Excitants, its active principle is also taken into the circulation and imparts its odour to the urine.

Captain Winter, who first brought this bark into notice, used it as a condiment in seasoning the food of his sailors, who were suffering under the ravages of scurvy; he also applied the leaves of the tree, in the form of fomentations, to their sores. Under this treatment they got well; but, as Murray justly remarks—"Nec ullam prærogativum præ aliis aromaticis huic considerare possum sub eo morbi gradu eaque conditione, qua aromata considerare possunt*." Winter's bark is, nevertheless, a valuable Excitant; and, in diarrhœas depending on a low condition of the habit, with deficient cutaneous action, the combination of the tannin with the volatile oil gives it an advantage over *Canella alba* which has not been taken into account. It has been more neglected than many less valuable medicines. In cases of dyspepsia which permit the use of Tonics, it is an admirable addition to simple bitters; with which intention it is more used on the Continent than in this country.

* Apparatus Medicaminum.

CANELLA BARK. *Canella Cortex*. L. *Canellæ albæ Cortex*. D.—Canella, the last bark in the list of Excitants, the active principle of which is volatile oil and resin, is the product of the *Canella alba**, a tree which is a native of Jamaica and some other of the West India islands. It belongs to the natural order Meliaceæ. The Canella found in the shops is the inner bark of the young branches freed from its epidermis. It is in pieces of from five to eight inches in length and two in breadth; some quilled, others nearly flat: but it varies greatly both in size, thickness, and quilling, according as it has been taken from younger or older branches. The interior of this bark is of a pale orange hue; the exterior whitish: it has the fracture of marble. *Canella alba* has an aromatic pungent taste, leaving a bitterness in the mouth: the odour somewhat resembles a mixture of cloves and pepper.

MM. Petroz and Robinet state that *Canella alba* contains saccharine matter, a bitter resinous principle, a very acrid volatile oil, gum, albumen, and fecula. Alcohol is its proper menstruum, taking up both the resin and the volatile oil; whilst water takes up the gum, fecula, and albumen, with a portion of its bitter, but very little of the volatile oil. The infusion, therefore, possesses scarcely any of the warmth and pungency of the bark. The infusion is not affected by tincture or infusion of galls, lime-water, tartar emetic, the salts of iron, or those of mercury; all of which, therefore, may be prescribed in conjunction with it; but, in consequence of the albumen it contains, it gives a precipitate with nitrate of silver; and, owing to the gum, it throws down subacetate of lead. The volatile oil can be obtained by macerating the bark and afterwards distilling it. This oil is thick, heavy, yellow, very pungent, and gratefully aromatic.

Canella alba is a powerful Excitant, an useful addition to tonic medicines in those cases in which a cordial is required, as in some varieties of dyspepsia and in atonic gout. From its not acting on the salts of iron, it is an excellent vehicle for these in the treatment of chlorosis and other diseases

* Woodville's Medical Botany, p. 694, pl. 237. Sloane's Jamaica, vol. ii, p. 87, t. 191, f. 2. London Dispensatory, art. *Canella alba*.

of cold, leucophlegmatic habits. It is a good adjunct to jalap, colocynth, and other griping purgatives. It is most useful when administered in the form of powder, in doses from gr. x to ʒss, and may be combined with sulphate of potassa, rhubarb, and other bitters. It enters into several officinal preparations.

* * * * *Flowers.*

THE CLOVE. *Caryophyllus*. L. *Caryophyllus aromaticus*. E. D.—The unexpanded flower of the *Eugenia Caryophyllata* is the officinal Clove. The tree which bears it is a native of the Moluccas*, and belongs to the natural order Myrtaceæ. It is a tall, handsome, evergreen tree, with a stem covered with a greyish, smooth bark†.

The Cloves are first procured from the tree when it is six years old. They are collected at Amboyna when they begin to redden, and are quickly dried by an exposure to heat and smoke, at a temperature of 120° Fahrenheit, until they assume their deep brown colour: after which the drying is completed in the sun. Those dried wholly in the sun are the best.

The Clove is the calyx of the flower, enclosing the ovary or germen. The unblown petals sometimes remain, and form a small, round head; sometimes they fall off, and leave the four points of the calyx to form the nail-like appearance of the Clove. Those Cloves which come from Molucca are the best. They ought to be of a bright brown colour, heavy, greasy, easily bruised, to have an agreeable, aromatic odour and an acrid, biting taste. They yield, by distillation, a large quantity of a heavy, highly pungent oil which is officinal—*Caryophylli oleum*.

* When the Dutch captured these islands from the Portuguese, they destroyed all the trees except those on the islands of Amboyna, Honimoa, Ana, and Nousalant. The French, however, in 1769, broke this monopoly of the Dutch, by introducing the tree into the isles of France and Bourbon, and their other colonies: in 1789, it was carried to the island of Dominica by an Englishman of the name of Buée; and, in 1803, it was introduced into Sumatra by Dr. Roxburgh.

† See Woodville's Med. Bot. third ed. p. 538, pl. 193. London Dispensatory, art. *Eugenia*.

Cloves yield their medicinal properties to water and alcohol. The infusion displays some remarkable properties when tested by reagents. It contains some gallic acid and much tannin, striking a deep black-blue with persulphate of iron, and precipitating copiously with lime-water and acetate of lead. Iodine does not affect it; but the three mineral acids produce a flocculent precipitate; and, after a short time, the nitric displays effects which would almost permit the supposition that brucia is present in the Clove. When nitric acid is added to the infusion, slightly warmed, it gradually assumes the deep bright red hue which brucia and morphia assume when treated with this acid. M. Bonastre, who observed the first part of this fact, ascribes it to the oil of the Cloves, acted on by the nitric acid; and he properly cautions against the conclusions that might be formed of poisoning by brucia or morphia when the contents of the stomach, tested with nitric acid, display this red appearance. According to the analysis of Tromsdorff, 1000 parts of Cloves contain 180 of volatile oil, 40 of scarcely soluble extractive, 130 of gum, 60 of resin, 280 of lignine, and 180 of water. M. Planché has found sulphur in them; and MM. Lodibert and Bonastre have discovered, in the Cloves of Molucca, a crystallized sub-resin, in fine needle-form rays, which they have named *caryophylline**, besides a green, acrid, aromatic, fixed oil. Caryophylline is rough to the touch and devoid of odour and taste: it is scarcely soluble in cold alcohol, but soluble in boiling alcohol; is not reddened by nitric acid; and does not produce any effect on vegetable blues reddened by acids.

In a medicinal point of view, Cloves are powerful Excitants, affecting the stomach so actively as to require much caution in their administration. An overdose, even of the infusion, disturbs greatly the cerebral function, causing vertigo, cephalalgia, and dimness of sight. By regulating the dose, the Clove is one of the most certain of this class of remedies. It is also an useful addition to simple bitters, in cases which require a strong and immediate stimulant effect to be produced on the stomach; as, for example, atonic gout affecting that

* Journal de Pharm. tome ii, p. 104.

organ. The Clove is generally administered in the form of powder or in that of infusion. It enters into several officinal preparations. The oil is also used as a corrigent to some drastic, cathartic gum-resins, the purgative power of which it considerably augments. The oil is also employed to destroy the nerves in decayed teeth, in which it acts almost like an escharotic. The dose of the powdered Cloves is from grs. v to grs. xii, larger doses being apt to excite inflammation of the stomach; that of the infusion from $\mathfrak{z}$ i to $\mathfrak{z}$ ii; the dose of the oil from m. i to vi, triturated with sugar, as an oleo-saccharum, and diffused in water.

SAFFRON. *Croci Stigmata*. L. *Croci Sativi Stigmata*. E. D.—Saffron is the dried stigmata of the *Crocus Sativus*. The active principle of Saffron is a volatile oil in combination with a peculiar principle named *polychroite*.

Polychroite is a red powder, having a weak but agreeable odour, and a slightly bitter taste: it colours the saliva yellow, is soluble in cold water, and in alcohol, ether, the fixed and volatile oils, and the alkalies. It is partially soluble in the vegetable acids: nitric acid changes its colour to green; but this disappears on the addition of water. Sulphuric acid acts upon it in a singular manner: it first becomes blue, then violet and green, and lastly brown: displaying those Cameleon changes which have given its name. Chlorine destroys its colour*. This principle was discovered by Bouillon la Grange and Vogel. It exerts no influence on the living system; it is merely the colouring principle which is united with the volatile oil in Saffron†.

The *Crocus Sativus*, the plant which yields Saffron and this principle, belongs to the Natural order *Irideæ*‡.

* Polychroite is separated from the other principles by infusing the Saffron in cold water, evaporating the infusion to the thickness of a soft extract; acting upon this with alcohol; filtering, and evaporating the alcoholic solution to one third. To separate the oil, a little potassa must be next added; and, having again saturated it with acetic acid, filter and evaporate, and the residue will be Polychroite. Ann. de Chimie, tome lxxx, p. 186.

† Journ. de Pharm. tome vii, p. 397.

‡ For the botanical characters of the plant, see Woodville's Med. Bot. p. 763, pl. 269, 3rd edit. and for an account of the manner in which the stigmata are prepared for medicinal use, see London Dispensatory, art. *Crocus*.

Saffron in its dried state, when good, has a yellow colour, mixed with a deep reddish orange; its taste is pungent and bitter, and it exhales an agreeable odour. When powdered, it is of a beautiful orange colour. According to the analysis of Vogel and Bouillon la Grange, Saffron contains

A colouring extractive matter (Polychroite).	66.
Volatile oil (the quantity undetermined).	
Wax	0.50
Gum	6.50
Albumen	0.50
Salts, with bases of Lime, Potassa, Magnesia .	2.50
Water and lignine	20.

100.00

Saffron yields its active principles to water, wine, proof spirit, alcohol, and ether.

Saffron was known to the ancients, and was employed by the Romans both as a medicine and for strewing the temples and theatres to infuse an agreeable odour through them. Suetonius, in his life of Nero, remarks—"In honorem Trajani balsama et Crocum per gradus theatri fluere jussit." Saffron is a native of Asia: it was brought to England in the reign of Edward the Third, by a pilgrim, who concealed a bulb of it in his staff, made hollow for that purpose.

Saffron was regarded as an Excitant of considerable power by the ancients. It is to the volatile oil that any stimulant power which it possesses is to be attributed. Its power may be judged of by the quantity in a given quantity of Saffron: 100 parts afford 3 of oil. It excite the nerves of the stomach, and is partially absorbed. It exhilarates the spirits, and, like other Excitants, the excitement it produces is followed by exhaustion: in large doses, it stimulates powerfully the brain, causing headache, convulsive laughter, coma, and delirium*; and it is said that fatal effects have followed the imprudent use of Saffron. Even the aroma, when the stigmata have been recently gathered, is reported to be nar-

* M. Hannin, Cours de Mat. Méd. tome ii, p. 329.

cotic. This power of exciting the nervous energy renders Saffron an useful addition to narcotics in many convulsive and spasmodic affections. Thus the liquid laudanum of Sydenham, which contains one ounce of Saffron in the pint, in combination with cinnamon and cloves, is the best preparation which I know, in cases that require the combined action of a narcotic and an excitant.

Much diversity of opinion exists with respect to the exciting powers of Saffron. The experiments of Dr. Alexander† would induce the belief that it is a very inert substance. My own experience does not accord with that of this distinguished physician; and I am disposed to attribute much of the contradictory evidence advanced on this subject to diversity in the goodness of the drug. There is no doubt that it is a powerful Excitant, operating chiefly on the nerves.

Much evil has been produced by the custom, prevalent among the lower classes, of administering Saffron at the commencement of fevers attended with cutaneous eruptions—as, for example, measles and smallpox—with the idea of throwing out the eruption.

Saffron is sometimes adulterated with the petals of the safflower, and the officinal marigold; but these frauds are of little consequence, as far as concerns the medicinal properties of the Saffron. A worse fraud is the mixing good Saffron with that which has been used and afterwards dried.

Saffron may be administered in the forms of powder, infusion, or tincture. The dose of the powder is from grs. x to ʒi; that of an infusion made with ʒss of the Saffron to half a pint of water is two table-spoonfuls once in three or four hours: the dose of the tincture is from ʒi to ʒii. It is an ingredient in several officinal preparations.

* * * * * *Fruits.*

PIMENTA BERRIES. *Pimentæ Baccæ*. L. *Myrti Pimentæ Fractus*. E. *Pimenta*. D.—Pimenta, or Jamaica

† Experimental Essays, p. 88.

Pepper, is the fruit of the *Eugenia Pimenta* of De Candolle, a tree which grows in great abundance in Jamaica, in the other West India islands, and in South America. Its situation in the natural system is in the order Myrtaceæ*.

The fruit of the *Pimenta*, as it is imported, is about the size of a small pea, of a dark reddish-grey or brown colour, rough, with a slight indentation on its upper surface. It contains two cells, each of which encloses a black hemispherical seed. This is the produce of Jamaica, and is regarded as the best kind of *Pimenta*. A kind of *Pimenta* is imported also from Tobago: it is larger than that of Jamaica, but is less valued, being considerably less aromatic. It is supposed to be the produce of a distinct plant, the *Myrcia pimentoides* of De Candolle†.

Pimenta has an agreeable odour, not unlike that of a mixture of cinnamon and cloves; and a pungent, hot taste, resembling that of pepper; properties dependent on the volatile oil which it contains, and which resides in the exterior coat chiefly, the kernel not containing one half the quantity which the outer coat yields. The volatile oil, separated by distillation, is of a deep reddish-brown colour, and very heavy. Sulphuric acid decomposes it rapidly; nitric acid acts on it with great violence, both acid and oil being decomposed.

Water takes up the active principles of *Pimenta*; and, in distilling the berries to obtain the oil, a considerable portion of the flavour and taste of the *Pimenta* being communicated to the water, this is used under the name *Aqua Pimentæ*. The active principles of *Pimenta* are also taken up by alcohol and ether. The spirit is officinal.

Besides the volatile oil and tannin, the *Pimenta* contains free gallic acid, which causes it to redden the vegetable blues; and on which account it renders the infusion incompatible with salts of iron. Nitrate of silver also throws down a precipitate. The mineral acids produce curious effects on the infusion. The sulphuric and the muriatic redden it, and

* Woodville's Med. Botany, p. 541, plate 291, 3d edit. London Dispensatory, art. *Myrtus*.

† *Prodromus*, tom. iii. p. 243.

thrown down pale, rose-coloured precipitates; whilst the nitric gives it a yellow hue, but no precipitate falls.

These effects of re-agents are explained by a knowledge of the constituents of *Pimenta*. The acids detected in a free state, are found to be the malic and gallic; the latter, in conjunction with the tannin, precipitates the salts of iron; the tannin and resin are affected by the mineral acids; whilst the nitrate of silver demonstrates that the saline ingredients contain a muriate. According to the analysis of M. Bonastre, 1000 parts of *Pimenta* contain—

	Skin.	Kernel.
Volatile oil	100.00	50.00
Green fixed oil	80.00	25.00
Tannin	114.00	398.00
Gum	30.00	72.00
Colouring matter and resin	52.00	—.—
Saccharine matter	30.00	80.—
Malic and Gallic acids	6.00	16.—
Stearine	9.00	12.00
Lignine and water	535.00	30.00
Saline matter	28.00	18.—
	984.00	702.00
Loss	16.00	18.00
Red insoluble matter	—	88.00
Pellicle, residue of Cotyledons	—	192.00
	1000.00	1000.00

In this ample display of constituents, the volatile oil is the only active medicinal agent; thence the oleo-saccharum of the Oil of *Pimenta* should be preferred to the berries.

As a medicinal agent, *Pimenta* is a powerful Excitant. It is particularly serviceable in the dyspepsia of broken-up constitutions, when much flatulence is present, and particularly when there is a tendency to atonic gout: but in every instance much caution is requisite not to give it with that red and glazed state of the tongue which indicates subacute inflammation of the mucous membrane of the stomach, and is a frequent cause of dyspepsia. In measles, smallpox, and

other exanthemata, when the fever assumes the typhoid character, the watery infusion of allspice, sweetened with sugar and mixed with a little milk, is taken without reluctance by children, and proves highly useful. The distilled water is an excellent vehicle for other medicines.

Pimenta may be administered in the form of powder, in doses of from gr. x to 3s. As the first impression on the stomach is considerable when the powder is taken, the entire berries are sometimes swallowed instead of the powder; but the best mode is to rub the Oil of Pimenta with sugar, to form an oleo-saccharum, or with some cretaceous powder which, absorbing the oil, obtunds the acrimony of its first impression.

CUBEBS. *Cubeba*. L. *Cubebæ fructus*. D.—A very natural and frequent combination of volatile oil that with resin exists in this species of Pepper, the fruit of *Piper Cubeba*, a member of the natural order Piperaceæ, and a native of the Indian Archipelago, Nepaul, and the Isle of France. In their appearance, Cubebs resemble black pepper, except that they are less wrinkled, and have pedicils attached to them: thence the name *Piper caudatum*. The volatile oil which they contain resides chiefly in the nucleus of the seed.

Cubebs have a fragrant, agreeable odour, and a pungent, aromatic, bitter taste, which leaves a sensation of coolness on the palate resembling that of Peppermint. The oil which they contain is so very volatile, that it is soon dissipated if they be bruised; and, therefore, Cubebs should not be kept in a state of powder. In the state of powder, also, Cubebs are sometimes adulterated with powdered Pimenta. According to the analysis of Vauquelin*, Cubebs contain—

- a volatile oil nearly concrete;
- a resinous matter;
- a small quantity of coloured resin;
- a gummy coloured matter;
- extractive;
- and some saline matters.

The volatile oil, when procured by distillation, is separable

* Journ de Phar. tom. vi, p. 309.

into two parts : a white concrete crystalline substance, and a pale greenish straw-coloured fluid oil, possessing the taste and odour of the Cubebs.

The powder of Cubebs, when taken into the stomach, acts primarily on the nerves of that organ, augmenting its nervous energy, and through it increasing the action of the heart and arteries : it is, however, quickly taken into the system, and is excreted by the kidneys, imparting its peculiar odour to the urine. The powder stimulates the intestinal canal through its whole extent, and imparts the same cool sensation in passing from the rectum as it leaves in the mouth.

In 1818, Mr. Crawford published an account of the advantages derived by the Hindoo practitioners from the administration of powdered Cubebs in Gonorrhœa, and confirmed it by his own experience and that of the English surgeons in Java. It is singular, that although Cubebs are indigenous in Java, where they are called Cummons, and had been long used in the diseases of children, yet they were never employed in Gonorrhœa until Mr. Crawford recommended them*. The experience of European practitioners has fully confirmed the value of this remedy in Gonorrhœa. To insure the efficacy of the powder, it should be kept in stopped phials ; or it is preferable not to powder it until it is to be used.

Regarding Cubebs as an Excitant, it may be demanded, in what manner do they cure Gonorrhœa, which is an inflammatory affection ? In replying to this question, we must bear in recollection that Cubebs are injurious in severe cases of the disease, when the inflammatory state is considerable, extending to the neck of the bladder, and accompanied with much symptomatic fever. In such cases I have seen them bring on bloody urine, strangury, and other violent symptoms. When these circumstances do not exist, and the disease is confined to the mucous membrane, the morbid action which exists there is of a specific nature ; otherwise a virus, resembling that which produced the disease, would not

* Edin. Med. and Surg. Journ. vol. xiv, p. 33.

be generated. Now, when Cubebs are taken into the stomach, the volatile oil, separated from the other parts by the digestive function, is absorbed, passes by the kidneys, and thence acts on the bladder and the urethra, during the excretion of the urine. A new action in these parts being thus probably induced, the diseased state is overcome; and this new action being afterwards gradually let down, the disease does not return.

It is also probable that the local effects of the Excitant on the intestinal canal may operate, in a certain degree, as a counter-irritant. This explanation is greatly confirmed by the fact that Cubebs produce little benefit, unless their effect be soon apparent.

Cubebs are administered most advantageously in the form of powder; but since the volatile oil has been obtained in a separate state, it is now extensively prescribed instead of the powder, and possesses the advantage of not losing its properties by keeping. When the powder is administered, it is digested in the stomach, as I have already stated, and the volatile oil, entering the circulation, is carried to the kidneys, which it stimulates, thereby augmenting the quantity of the urine, and imparting to it their odour. Some of the benefit derived from Cubebs is undoubtedly due to this augmented secretion of urine, which assists in washing out the virus existing in the urethra; but the inflammation and the pain is already abated; so that more depends on the specific action of the medicine than on its diuretic power. That this is the fact, is demonstrated by the utility of Cubebs in chronic inflammation of the bladder. When they prove useful in Gonorrhœa, the discharge is checked, and the inflammatory symptoms are allayed in less than eight or ten days; and when this does not occur, they seldom prove beneficial. Another very striking symptom, which is indicative of their proving curative, is that peculiar sensation of coldness in the rectum, when the fœces are passed, which I have mentioned. I have rarely found that they fail when this symptom presents itself. The dose of the powder of Cubebs sufficient to produce the usual effect of the medicine, is from $\mathfrak{z}\text{i}$ to $\mathfrak{z}\text{ss}$: but it

is, sometimes, requisite to augment the dose to $\mathfrak{z}\text{i}$, three times a day. The best vehicle for administering the powder is milk.

A tincture of Cubebs is ordered by the Dublin College, but, as far as regards the employment of this pepper in Gonorrhœa, it is a bad form of preparation. It is a mere alcoholic solution of the volatile oil. It may prove useful in chronic rheumatism, in some cases of which Cubebs are stated to have afforded great relief*.

In some habits, Cubebs excite great irritation and fever. In a case recorded by Mr. Brodie, in the first volume of the Medical Gazette, this irritation was so considerable, from the administration of $\mathfrak{z}\text{i}$ of the powder of Cubebs, that it tended to hasten the death of the patient. Mr. Broughton has also recorded a similar case in the same publication, in which temporary paralysis followed the use of Cubebs in doses of $\mathfrak{z}\text{ii}$ three times a day. In one case, which fell under my own observation, in which the extent of the dose was $\mathfrak{z}\text{i}$, so much febrile irritation was also excited, that the life of the patient was in danger. The frequent occurrence of these deviations from the usual mode in which the medicine affects the system, demonstrates the necessity of the practitioner looking closely after his patient on every increase of the dose of Cubebs. It is not unlikely that such occurrences were the cause of the remedy falling into disuse; for, although it formerly was much prescribed in some diseases, yet it had been neglected for many years, when it was again introduced for the cure of Gonorrhœa and of Gleet, for which it had long been employed in India. The Arabs use Cubebs for seasoning food.

Some cases of Leucorrhœa are recorded in which the administration of Cubebs seems to have been highly beneficial†; but, in prescribing them, the state of the uterus should be ascertained, as Cubebs might augment greatly any organic disease in that organ.

It does not appear that the ancients were acquainted with Cubebs, notwithstanding the term Koubeba is used by Arc-

* See Dr. Crane's observations, *Edin. Med. and Surg. Journ.* vol. xxi, p. 305.

† *Edin. Med. and Surg. Journ.* vol. xv, p. 318.

tuarius; and has led some, as Murray in his *Apparatus Medicaminum* remarks, to suppose that he was the first who used them.

Even in the time of Murray, Cubebs were not used for the cure of Gonorrhœa, or any inflammatory state of the mucous membrane. They were chiefly employed as a stimulant in dyspepsia, particularly in that variety of it attended with vertigo; and in hysterical affections. We are indebted for our knowledge of their utility in diseases of the urinary organs solely to the natives of India.

LAUREL BERRIES AND LEAVES. *Lauri Baccæ et Folia*. L. E. D.—These berries contain volatile oil combined with mucilage and other vegetable principles. In the leaves, the volatile oil is deposited, in an uncombined state, in distinct cells. The plant is the *Laurus nobilis*, or Bay tree, the type of the order Laurineæ*.

It is a beautiful evergreen tree, rising, in favourable situations, upwards of twenty feet in height; it is found in most of the countries of southern Europe, as France, Spain, Italy, and Greece†. The Greeks named it *Δαφνη*, and have connected many fables and beautiful allegories with its history; they also endued it with many superstitious powers and imaginary virtues: but, whilst we admire the elegance of the minds that conceived these poetic fictions, and pay our tribute of admiration to the beauty of the antique gem in which Æsculapius, crowned with a wreath of the sacred Laurel, is represented as the son of Apollo, we must not forget that our search is after truth, unadorned by fiction.

Both the *leaves* and the *berries* of the Laurel have an aromatic flavour, joined to a bitterness, and leave on the palate an astringent sensation. When bruised, the leaves have an

* The classical character of the Laurel, as forming the groves of Parnassus, and as the favourite plant of Apollo, is universally known; but few are perhaps aware that it has also been employed in crowning medical proficientes. “*Nec non*,” says Geoffrey, “*quibusdam in locis novi Medicinæ Doctores Laura coronantur: inde fortasse Laureandi et Laureati dicuntur.*”

† Woodville's *Med. Bot.* 3d ed. p. 678, pl. 285. London Dispensatory, art. *Laurus*.

agreeable fragrancý. M. Bonastre has analysed Laurel berries, and found in them—1. volatile oil ; 2. a peculiar crystalline matter, which he has named Laurina ; 3. fatty, green-coloured oil ; 4. stearine ; 5. fecula ; 6. gummy extract ; and 7. lignine.

Distillation obtains a *small* proportion of the volatile oil. On this their excitant power depends : but it is too feeble to merit much attention ; and, upon the whole, the Laurel might easily be spared from the list of the *Materia Medica*.

It may not be out of place to notice here an oil which has lately been imported from South America, under the name Laurel oil. It is a pure, colourless, warm, pungent, aromatic oil, of a sp. gr. not exceeding that of alcohol. It has all the usual chemical properties of volatile oils ; and is a solvent of camphor, caoutchouc, wax, and resin. The tree which yields it is said to be a Laurel, but this is uncertain : it is a native of South America, between the rivers Parime and Oronooko. The oil is procured by merely striking the tree with an axe, so as to divide the proper vessels, when it gushes out in such abundance that several quarts of it are obtained from a simple incision. This oil has been advantageously employed, as an internal stimulant, and, as a rubefacient, applied to the skin in chronic rheumatism.

***** *Seeds.*

CARDAMOM SEEDS. *Cardamomi Semina*. L. D. *Amomi Repentis Semina*. E.—The active principle of the Cardamom is volatile oil, which is deposited in the testa or skin of the seeds : nearly the whole of their substance besides, or the cotyledons, consist of fecula. Newman obtained 20 parts of volatile oil, 15 of resinous extract, and 45 of aqueous extract, from 100 parts of these seeds : the existence of the resin, however, is doubtful ; for ether, digested on the seeds and evaporated on the surface of water, leaves nothing except volatile oil.

The Cardamom is the seed of a plant which was formerly regarded as an Amomum, but which the investigations of

Mr. Roscoe have proved not to belong to that genus. Dr. Maton endeavoured to fix the true botanical characters of the plant, which he named *Elettaria Cardamomum*, from the Malabar name, *Ela-tara*, applied to the ripe capsule of the seed: but it has since been named *Matonia*, in honour of Dr. Maton, and stands under that name in the list of the London Pharmacopœia. It belongs to the natural order, Scitamineæ, and grows native on the range of the Gaughts, in Malabar, and also in Cochin China*.

Cardamom seeds are imported in capsules. In separating these from the racemes, they are sorted into three classes, *Valli Kai*, *head fruit*; *Nadu Kai*, *middle fruit*; *Poulo Kai*, *abortive fruit*: the two first of which, mixed together, constitute the Cardamoms brought to Europe. Cardamom seeds, separated from the capsules, are of a deep brown colour, angular, corrugated, pulverulent; have an agreeable aromatic odour, and a warm, spicy taste. Both water and alcohol extract their virtues. The watery infusion has a turbid appearance, is coloured blue by tincture of Iodine, and lets fall slight precipitates on the addition of alcohol and the acids; precipitates are also produced in it by sulphate of iron, bichloride of mercury, and acetate of lead. Cardamoms seem to consist entirely of fecula, mucus, and perhaps some resin, and volatile oil.

In a medicinal point of view, Cardamoms are excitant; but they are chiefly employed, as aromatic additions to tonic medicines, in dyspeptic and gouty affections. They are sometimes ordered in combination with magnesia and rhubarb, in the flatulent colic of infants. The dose of the powder for an adult is from ten grains to a scruple. They are said to be stimulant, but not heating like other aromatics—a distinction which I cannot understand. The London College orders two tinctures of these seeds: one a simple tincture, which may be regarded as a solution of the volatile oil in proof spirit; the other is one of those curious combinations which display neither ingenuity nor judgment in the inventors—a

* Woodville's Med. Bot. third edit. p. 734, pl. 251. London Dispensatory, art. *Matonia*. Linn. Trans. vol. x. p. 229.

combination of the volatile oils of the Cardamom, caraway, and cinnamon, coloured with cochineal and sweetened with raisins.

THE NUTMEG. *Myristicæ Nucleus*. L. E. *Nux Moschata*. D.—A useful combination of volatile oil and fixed oil is found in the Nutmeg, the fruit of the *Myristica Moschata**, the only medicinal plant of the natural order *Myristicæ*. This tree grows in the Molucca Islands, but is chiefly found in the Island of Banda. Before 1770, the whole of Europe was supplied from the Moluccas with this spice ; but, at that time, the *Myristica Moschata* was carried to the Isle of France and there perfectly naturalized. It is also now cultivated in Cayenne and the West Indies†. We are told that the tree is not planted, but is propagated by a species of pigeon, which swallows the fruit entire ; and, as the exterior covering and the mace only are digested, the Nutmeg is passed through the bowels of the bird in a state which is supposed to be very favourable for its germination. But, notwithstanding this account, the tree is also planted in the usual manner in Banda‡.

There are two kinds of Nutmegs found in commerce, the *wild* and the *cultivated*. The former is long, pointed,

* Woodville's Medical Botany, third edition, p. 698, pl. 238. London Dispensatory, art. *Myristica*.

† The tree has also been discovered in New Holland, the Southern Peninsula of India, and Cochin-China ; but Mr. Crawford, in his History of the Indian Archipelago, affirms that the Nutmegs in these places have no aromatic properties, and are consequently useless.

‡ Many Nutmegs drop from the trees ; but those only which are regularly plucked are exported to Europe. A good nutmeg tree yields from ten to fourteen pounds of nutmegs annually ; but in this there are eight pounds only of *Nutmegs*, strictly speaking, two pounds being *Mace* and the remainder, or four pounds, *shells*. It is a curious fact, in political œconomy, that the consumption of Nutmegs and Mace in Europe has greatly diminished since the middle of the eighteenth century. although the price has also considerably diminished. In 1615, about 100,000 lbs. of Nutmegs and 15,000 lbs. of Mace were consumed in England : at present the consumption is only 56,960 of Nutmegs and 3620 of Mace. In Europe, two centuries ago, the consumption of Nutmegs was 400,000 lbs. ; that of Mace 150,000 : at present (1832) 214,720 lbs. of Nutmegs and 250,040 of Mace are consumed.

lighter and less aromatic than the cultivated Nutmeg. The shell, which is covered with a cottony down in the wild, is naked and smooth in the cultivated Nutmeg. The Nutmeg is nearly round; its consistence is hard and unctuous; its odour strong, aromatic, and agreeable; its taste oily, hot, and acrid. When it is cut transversely and examined by the microscope, the dark-coloured veins are found to consist of cellular matter filled with the fluid volatile oil of the Nutmeg. The arillus or mace is divided into longer laciniae, is thicker, more unctuous, and of a deeper orange hue than that of the wild Nutmeg. Both the Nutmeg and the Mace are eaten and perforated by the larva of the *Dermestes Surinamensis*. Nutmegs are also occasionally punctured and boiled to obtain the volatile oil; and the orifices afterwards closed with powdered Sassafras. This fraud is detected by the lightness of the Nutmeg*. According to the analysis of M. Bonastre, 100 parts of Nutmeg contain—24 of an insoluble, white matter (stearine); 7.6 of a soluble, coloured butter (elaine); 6.2 of a volatile oil; 0.6 of an acid; 2.4 of fecula; 1.2 of gum; and 58.0 of ligneous matter†.

The Nutmeg yields its volatile oil by distillation. The oil is one of the few produced in tropical climates lighter than water: it possesses the odour and taste of the Nutmeg. Nutmegs, when heated, yield also to the press a concrete oil which entangles, like a sponge, some of the volatile oil.

The *Mace*, which is the arillus of the Nutmeg, and surrounds the nut within the drupe, yields also a very acrid, volatile oil. The Mace itself is a thick, deeply divided, fleshy, reddish membrane, having an agreeable, aromatic odour, and a hot, biting taste. Besides the volatile, it contains also a fixed oil. According to M. Henry, *Mace* contains—1. a small quantity of volatile oil: 2. a large quantity of a yellow odorous, fixed oil, soluble in ether, but insoluble even in boil-

* Formerly the Nutmeg was always imported in the shell, as in this state they can be long preserved; but the Dutch, in order to increase the demand for the annual produce of their newly acquired islands, and to secure their monopoly by sending the kernels in a state not fit to germinate, introduced the practice of freeing them from the shells; in which state the Nutmeg is the most perishable of seeds.

† Journal de Pharm. Juin 1825.

ing alcohol: 3. a nearly equal quantity of a red, odorous, fixed oil, soluble both in ether and alcohol: 4. a gummy matter, forming about a third of the weight of the Mace: and 5. a small quantity of woody matter*.

The use of the Nutmeg as a medicinal agent is as old as Avicenna, who first employed it medicinally. It is used chiefly as a grateful aromatic addition to some tonics that are apt to excite nausea and vomiting. It is also employed to relieve vomiting when it is present. The *Mace* answers for the same purposes as the Nutmeg; but neither is employed much except as agreeable aromatic additions to other medicines. The volatile oil is sometimes ordered, in the form of an oleo-saccharum, in flatulent states of the stomach and intestines, and in atonic gout attacking the stomach. It is also useful, in moderate doses, in dyspeptic states of the digestive organs, and in the diarrhœa of relaxed bowels.

The concrete oils of Nutmegs and of Mace are employed as local Excitants in neuralgic and rheumatic pains; and, with this view, they form a component of an useful stimulant application, the compound pitch plaster of the London Pharmacopœia.

The only officinal preparation of the Nutmeg is a distilled spirit, which is a simple solution of the volatile oil in diluted alcohol; but it forms a part of several other preparations.

When the Nutmeg was formerly much employed as a condiment, and taken in large quantity, it was found to produce symptoms indicating great determination to the head; on which account it should be cautiously used in apoplectic and paralytic habits. It is probable that the oil separated by the digestive function is taken into the circulation, and, being conveyed to the brain, favours congestion in that organ. Cullen mentions the case of a person who took two drachms of powdered Nutmeg: an hour afterwards he was seized with drowsiness, which increased to stupor and insensibility; and, not long after, he was found fallen from his chair, lying on the floor of his room. This state was succeeded by delirium, from which he did not recover for six hours†.

* Journal de Pharm. tome x, p. 281. † Cullen, Mat. Med. vol. ii, p. 204.

Such are the properties, physical, chemical, and remedial, of Volatile Oil, both in its uncombined and combined state. The bounty of Nature, in supplying it in such variety, is more to be admired than the wisdom of the framers of Pharmacopœias, in arranging in the Materia Medica so many substances the operation of which may be justly regarded as alike in every particular. If we take a review of the various articles contained in the list which has been just gone through, and select from the uncombined volatile oils those of Cajuputi, Peppermint, Rue, and Lavender, and from among the substances containing combined volatile oils, Caraway seeds, Acorus Calamus, Ginger, Serpentaria root, Cubebs, Winter's bark, Cinnamon, and Pimenta, we shall possess ample means for fulfilling every indication for which Excitants of a vegetable nature can be required in the treatment of diseases.

b. CAMPHOR.—*Camphora*.

L. E. D.

Camphor is a solid, white, transparent, very volatile, combustible substance, unctuous to the touch and closely allied to the essential oils. It is friable, and breaks with a crystalline fracture; but, nevertheless, it is ductile and therefore not easily pulverized. It has a penetrating, peculiar, fragrant odour, and a bitterish, hot, and acrid taste, which is followed by a sensation of coldness on the palate. Owing to its volatility, it is gradually dissipated when exposed to the air, and, if kept in a covered glass vessel, crystallizes in hexagonal plates in stars on the side exposed to the light. Its specific gravity is 0.988; it therefore swims in water. At 288° Faht. it melts, and boils at 400° Faht.: it is readily ignited, and burns with a brilliant flame, forming much smoke.

Camphor is scarcely soluble in water; but, when triturated with it, enough is dissolved to communicate both odour and taste to that fluid. Ether, alcohol, strong acetic acid, fixed and volatile oils, carbonic acid, and the minerals acids diluted, dissolve Camphor, which is again precipitated by adding water to the solutions. Strong sulphuric acid converts it into artificial tannin: when acted upon by nitric acid, it becomes Camphoric acid.

According to the analysis of Dr. Ure, Camphor appears to consist of 10 equivalents of carbon (6×10) = 60, + 1 of oxygen = 8, + 9 of hydrogen ($\times 9$) = 9: = 77. But chemists have differed in their statements of the elements of Camphor, as the following table demonstrates:

ELEMENTS.	NAMES OF CHEMISTS.				
	Gold.	Fée.	M. De Saussure	Thomson.	Liebeg.
Carbon. . .	74.67	74.38	74.38	73.91	81.376
Oxygen . .	14.09	14.61	14.71	11.60	8.535
Hydrogen .	11.24	10.67	10.67	14.49	9.722
Nitrogen . .	0.0	0.0	0.34	0.0	0.0

The sources of Camphor are various; each producing a modification or variety of the substance. That brought to this country and employed in medicine, which may be taken as the standard, is procured by distillation from the roots and smaller branches of the *Laurus Camphora* and *Sumatrensis**. Another variety, which is also medicinally used, although very little known in this country, is found concreted in the interior of the *Dryobalanops Camphora*†. All the essential oils of the Labiatae deposite it in crystals when they are freely exposed for a long time to the air. M. Proust has ascertained that 100 per cent. of Camphor are obtained from the oils of Rosemary and Majoram, $12\frac{1}{2}$ from oil of Sage, and 25 from that of Lavender‡. The volatile oils of some of the Scitamineæ—for instance, those of Zedoary, *Maranta galanga*, *Kœmpferia rotunda*, and *Zingiber officinale*—also yield Camphor: and it has been procured from the roots of *Anemone pratensis*, *Asarum Europeum*, *Andropogon Schœnanthus*, *Inula Helenium*, and some species of the genus *Aristolochia*: an artificial variety is obtained by passing a stream of dry muriatic acid gas through purified oil of turpentine in a vessel surrounded by a mixture of snow and salt§. The difference in

* Woodville's Medical Botany, third edition, vol. iv, p. 681, pl. 236. London Dispensatory, art. *Laurus*.

† Woodville's Medical Botany, third ed. vol. v, p. 124. Colebrook, Asiatic Researches, vol. xii, p. 539. London Dispensatory, art. *Dryobalanops*.

‡ Journal de Phys. Mars. 1790.

§ Zea describes a species of Camphor, called *caratti* in South America, which exudes in tears from the bark of a tree.

these varieties is considerable: thus, the Camphor of the Dryobalanops differs from that of the Laurel in being “ opaque, of a chalk-white colour, in tabular plates, pulverizable without the aid of alcohol, and remaining in powder without agglutination; its specific gravity is greater also than water, and it does not spontaneously sublime*.” The other varieties are still more distinct in their characters. A fluid Camphor, said to be the produce of the Dryobalanops, has also been brought to Europe under the name of oil of Camphor, and possesses excitant powers similar to those of the volatile oils.

As an Excitant, Camphor was introduced into practice by the Arabs, who called it *Canfur* and *Cafur*. It does not appear to have been known to the Greeks and Romans; but it was in common use in the time of Paracelsus. Its distinct character, however, was not known until Neuman published an account of it in 1725, and proved that it is neither a *volatile oil* nor a *resin*: yet it is still frequently prescribed under the name Resin of Camphor.

In examining the medicinal influence of Camphor, its local as well as its general effects on animal life should be taken into consideration, to aid us in fixing its claim to the character of an Excitant.

In its volatile form, mixed with the air, it operates as a powerful poison to many insects: thence its use in preserving clothes and vegetable matter from the destructive attacks of moths. It also destroys warm-blooded animals in the same manner, as was proved by the experiments of Carminati on birds†. When given to quadrupeds by this physiologist, and also by Menghini‡, various effects were produced; but in all it appeared to operate as a powerful stimulant: some became furious; others were oppressed with stupor; some were attacked with violent convulsions. Two drachms given to a dog brought on symptoms very closely resembling those of hydrophobia. Post mortem examinations displayed the stomach to have been in a state of active inflammation. In those

* Supplement to the Edinburgh New Dispensatory by Dr. Duncan, p. 52.

† De Animal. ex nephitis interitu, p. 186. ‡ Comment. Benon. t. iii, p. 314.

animals that suffered from stupor, the meninges of the brain, the lungs, heart, and intestines, were inflamed.

Camphor, when taken into the human stomach, excites a glow of warmth at the epigastrium, with an uneasy sensation : it is generally supposed to operate by its action on the nervous energy, which it is said to increase without raising the pulse ; and this idea is thought to be supported by the transitory nature of its action. But the opinions on this point have been very opposite. Boerhaave, Stahl, and Neuman, maintain that it acts chiefly on the heart and arteries, increasing their impetus ; while Hoffman, Burserius, Cullen, and others, contend that the action and force of the pulse are diminished. Cullen even asserts that he never found the pulse quickened, or the heat of the body increased, by giving it to the extent of half an ounce in the day. Dr. Alexander, who made many experiments on his own person with this medicine, concluded that it diminishes the temperature of the body and the celerity of the pulse : but, beyond a certain point, it produces the opposite effect. Having taken a very large dose of it, he was found foaming at the mouth ; and his pulse quick, full, and hard ; and on his recovery, which did not take place until after six hours had elapsed, he complained of violent headache. His recovery was facilitated by drinking tepid water, which brought up part of the undissolved Camphor by vomiting. It is probable that, like opium and some other substances, the first effect of Camphor is excitant. There are differences of opinion regarding the mode in which its stimulant effects are produced : some contending that it passes into the circulation and is exhaled like sulphur by the skin, stimulating the system in *transitu* ; others that it acts chiefly on the nerves, and excites the skin by the sympathy which exists between it and the stomach. I confess that my observations and experience induce me to adopt the latter opinion.

The first effect of a full dose of Camphor is certainly derived from its local stimulant power ; as, in swallowing the dose, it is felt warm in the throat ; and this sensation continues for a considerable time afterwards, sometimes occasioning thirst. Its influence on the gastric nerves is then propagated

to the brain, the spinal marrow, and the whole ganglionic system. During this time the heat of the surface is diminished, rigors sometimes occur, and vertigo supervenes, with perverted vision. The second general effect is one of increased action: the pulse becomes strong, frequent, and vibrating; the heat of the body is augmented; the surface is redder; the eyes glisten; and cephalalgia occurs. It cannot be denied that this stage is probably the result of its absorption. Experiments made on living animals, by injecting Camphor into the rectum, have demonstrated that it soon pervades all the tissues, and is made sensible in them by its odour: and dogs thus treated often die in convulsions.

The medicinal use of Camphor has been little regulated by the opinions formed of its mode of acting. Even those who regard it as an Excitant—on observing that, when taken in moderate doses, it softens and fills the pulse, and promotes diaphoresis, mitigates pain, dissolves spasms, and seems to rouse the nervous energy, without quickening greatly the pulse—have considered that it may be given in diseases of excitement, particularly when it is combined with antimonials. It can only, however, be administered in small doses in such cases; and much injury may result from its local influence, even in small doses, where there is subacute inflammation of the stomach or intestines. It is said to obviate the irritating and stimulant effects of opium and other narcotics; and it has been much employed in maniacal affections. Its influence, nevertheless, as an Excitant, is much increased by combining it with small doses of opium: in which combination, also, it determines powerfully to the skin.

Camphor has been found extremely serviceable, as a stimulant, in low fevers, of that description which are termed putrid: an effect which Sir John Pringle, in his Essay on Putrefaction, ascribes to the antiseptic power of Camphor; but which is, undoubtedly, owing to its excitant properties: and it is in the latter and sinking stages of these fevers that its influence is most beneficial. Whether, in such cases, the benefit is to be ascribed to the absorption of the remedy admits of doubt. The quantity that may be administered in these cases is so regulated by circumstances that it is impos-

sible to lay down any rules respecting it. In some persons, a few grains excite powerfully ; whilst others, in these fevers, can take ʒiii or ʒss in the course of the day, not only with impunity, but even with advantage. In these cases it is advantageously combined with Peruvian bark or the salts of quinia or cinchonia, or with serpentaria, and aromatics. In gangrene, whether of the dry or humid kind, Camphor is found to aid greatly in stopping its progress and enabling the sound parts to throw off the diseased. In these cases, its excitant properties are those to be looked to. It is, also, usefully employed, as a local stimulant, sprinkled on gangrenous sores. For the same reason, it is a beneficial addition to aromatics and opium, in cases of smallpox, measles, and other eruptive fevers, when these assume a typhoid character and the eruption suddenly recedes. In erysipelas it has been given, in large and repeated doses, with the best effects. It has been employed with success in many affections proceeding from a morbid state of the encephalon, and the medulla spinalis. Thus it quiets cough, arrests palpitation, relaxes spasms, and allays vomitings and intestinal pains which have, often, been erroneously ascribed to inflammatory states of the affected organs.

When Camphor is applied to the sound skin, it stimulates, causing redness, heat, and increased action in the part ; thence it is advantageously employed, as a rubefacient, to relieve internal pains ; but, like all other local stimulants of a transitory nature, it is apt to favor metastasis, or a translation of inflammatory action, in these cases, when there is any febrile excitement ; and, therefore, it ought never to be employed in acute rheumatism and similar affections ; although, in chronic rheumatism, a solution of Camphor in fixed oil, used as an embrocation, is often highly beneficial. A fact, however, should be noticed, which is, at first sight, apparently at variance with the local stimulant effects which have been just mentioned : when a lotion with Camphor is applied to a hot and inflamed surface, instead of stimulating, it acts as a refrigerant, producing an agreeable coolness—a circumstance depending on the great volatility of the Camphor.

Camphor may be administered in various forms. It is

readily reduced to powder by the aid of a few drops of alcohol, and in this state may be suspended in various vehicles by means of mucilage ; or it may be given in the form of powder ; in combination with magnesia, aromatic powders, or bitters, according to circumstances. Its insolubility in water renders that vehicle an unfit one for administering it, unless it be suspended by means of mucilage or yolk of egg ; or, what is preferable, by first dissolving it in olive oil, and then forming this into an emulsion with mucilage of gum and water, or with almond mixture. An emulsion is formed by triturating it with blanched almonds and sugar, according to the directions of the Edinburgh Pharmacopœia : but, in this case, the quantity of oil contained in the almonds is insufficient to keep the Camphor in solution ; and, consequently, it soon separates and swims on the surface of the water. As an extemporaneous form of prescription, however, Camphor may be advantageously ordered in this form. Dr. Cassils, of Kendal, recommends milk as a solvent of Camphor : ʒss of Camphor is formed into an excellent emulsion when triturated with fʒiv of milk and fʒviiss of water*.

Opinions have varied, even regarding the doses of Camphor. The usual dose is from two grains to a scruple ; but on the Continent it is given to a much greater extent. Gizeke began with ʒss and increased the dose to ʒi. Stoll and other Germans have given it as freely ; and Cullen asserts that he never found the pulse quickened, or the heat of the body augmented, by giving it to the amount of ʒiv in the day. As far as my own experience has enabled me to judge, I have never seen its excitant effects produced by less than grs. viii given for a dose ; and I have never had occasion to increase it beyond a scruple ; repeated every fourth hour. Professor Hallé has remarked that Camphor, mixed with nitrate of potassa, administered in the interval of intermittent fever, prevents a return of the paroxysm ; thus acting as an *anti-periodical*.

As an external Excitant, Camphor is employed in solution in acetic acid, alcohol, and fixed oil : it also enters as an in-

* Edin. Med. and Surg. Journ. vol. vii, p. 124.

gredient into stimulating liniments ; compound soap liniment, for instance, and the compound soap liniment with opium. In my opinion, the most useful vehicle for its external application is oil, both on account of the minuteness of its division in that vehicle, and also the facility of its application. In all those cases in which its external application is indicated, the object is to produce a counterirritant effect ; and, therefore, that vehicle must be the most useful which restrains its volatile properties, as is the case when the fixed oils are employed. I cannot comprehend what advantage is to be expected from its solution in acetic acid ; as that agent is a more powerful rubefacient than the Camphor. It may aid the anodyne effects of opium, as an external application, when conjoined with it in a small quantity. Camphor is also used externally as a fumigation : the patient is covered with a blanket, tied or pinned close round the neck ; half an ounce, or more, of Camphor is then thrown on an iron plate placed over a small chafing dish, within the blanket. The effect is a more copious perspiration than would be produced by the heated air. According to M. Dupasquier, an absorption of Camphor by the skin takes place : if this be correct, it might prove an excellent addition to heated air in cases of malignant cholera.

C. ACRID FIXED OIL.

I have had occasion several times to notice Acrid fixed oil as a secondary principle in vegetable Excitants : in the substances which are now to be examined it is the active principle. It is not, however, the oil which is the Excitant in these substances ; the fixed oil is merely the vehicle of the acrid principle, whatever that may be. In our endeavour to investigate its nature, let us first ascertain that of the vehicle in which it is presented to us.

Fixed and volatile oil agree in some of their properties. Thus they are both extremely fusible, being either always liquid at the ordinary heat of the atmosphere, or becoming so when exposed to a very slight elevation of temperature : both are very combustible, insoluble in water, altered by exposure to the air, and acted upon with energy by the mineral acids. The sulphuric acid thickens them, and forms a tenacious

soapy compound: strong nitric acid rapidly decomposes them, and itself suffers decomposition, in some instances causing combustion. Chlorine also renders them thick and viscid. On the other hand, fixed oils differ from volatile oil in being, with two or three exceptions, sparingly soluble in alcohol and ether, in leaving an unctuous stain on paper, and forming true soaps with the alkalies.

Fixed oils are compounds of two distinct substances; one of which Chevreul, who discovered both, has named *stearine**, a solid crystallizable substance; the other *elaine*†, which is a fluid‡. These substances seem to be mechanically mixed in fixed oils; as they can be obtained in a separate state by submitting the oil, at a very low temperature, to strong pressure between folds of blotting paper: the elaine is absorbed, whilst the stearine remains in the solid state. They are also procured by boiling the fat oils in alcohol: the *stearine* crystallizes as the alcohol cools, and the *elaine* remains in solution. *Elaine* constitutes the greater part of the fluid fixed oils: it retains its fluidity at 20° Fahrenheit.

Fixed oils exist in the vegetable bodies in a state which is not readily understood: but the greater part seem to be uncombined, in distinct cells; as they can be procured by simple pressure and by ebullition. They are in this state in the kernels of many seeds, in which they abound; but, in roots, bark, and wood, in which they occasionally appear, they are intimately combined with the other principles of the plants. They are of various consistence; some being always in the liquid state, others always of a consistence similar to that of butter. All the vegetable fixed oils are lighter than water. They do not ignite until they are brought to a state of vapour; and it is on this account that wicks are requisite in the ordinary combustion of fixed oils; by enabling a small quantity to be successively exposed in the liquid state to a temperature sufficient for its combustion. If the whole oil be consumed during combustion, only water and carbonic acid are formed; but, in general, a portion of the oil is imperfectly decomposed, and appears in the form of soot.

* From the Greek word *στέαρ*, suet.

† From *ελαιον*, oil.

‡ Ann. de Chimie, tome lxxiii, p. 225.

As I have already stated, the fixed oils are insoluble in water; but they are readily suspended in it by means of mucilage, forming emulsions. They are partially soluble in alcohol and ether, in very different degrees: thus, scarcely any Olive oil is taken up by alcohol, whilst Castor oil is soluble in it in any quantity. They combine with many of the metallic oxides; and this combination with oxide of lead is the basis of the officinal plasters.

When the fixed oils are analysed, they are found to be composed of different proportions of Carbon, Hydrogen, and Oxygen. If we take olive oil as the purest specimen of fixed oil, the proportions, according to Gay-Lussac and Thenard, are—

10 prop. Carbon	$(6 \times 10) = 60$	or 77.213
1 ——— Oxygen	$. . = 8$	9.427
11 ——— Hydrogen	$(1 \times 11) = 11$	13.36
Equiv. = 79		100.000

But olive oil consists of 72 parts of Elaine and 28 of Stearine; the ultimate principles of which, according to M. Chevreul, are—

	Carbon.	Oxygen.	Hydrogen.
Elaine .	29.030	9.548	11.422
Stearine .	78.776	9.445	11.770

Such is fixed oil. It is not so easy to determine either the general properties of the acrid principles dissolved in it, or the part in the plants which they occupy; but it is probable that the situation is perfectly distinct from that of the fixed oil in the living plant; and that it combines with the fixed oil only in the press. This opinion is rendered highly probable by the fact, that the seeds of the castor oil plant, *Ricinus communis*, when treated with strong alcohol, yield up the acrid principle to the alcohol, leaving the fixed oil, which can be afterwards pressed out in the usual manner; and when it is thus obtained, it possesses only the bland qualities of ordinary fixed oil. The Vegetable Excitants, which depend on acrid fixed oil for their active properties, are Black and Long Pepper, Mustard, and Pellitory Root.

PEPPERS.

a. BLACK PEPPERS. *Piperis Nigri Baccæ*. L. E. D.—Pepper is the fruit of a trailing or scandent plant, *Piper Nigrum**, a native of the East Indies. It is most successfully cultivated at Sumatra and Malacca, in Java, Borneo, and of late years in Cayenne. The plant is arranged in the natural order Piperaceæ, of which it is the type†. The entire dried fruit, which has a black colour and is shrivelled on the surface, is known by the name *Black Pepper*: when the external coat is removed, the seed exhibits a pale yellow colour, and is therefore called *White Pepper*. Both kinds are imported in great abundance into Europe, not only for the purpose of medicine, but as a condiment most extensively and generally employed. In the latter character, when moderately used, it aids the digestive powers of the stomach; and, on account of the artificial manner of living in cultivated society, it appears almost an essential of life; enabling the stomach to retain many substances which would otherwise prove highly offensive to it.

The Black Pepper is gathered as soon as the first berries of the spadix ripen; and it is not unusual to gather them green, if they have attained their full size. When gathered, the fruit is spread out upon mats, or smooth spots of clean, hard ground, where it soon dries and loses its green colour, becoming black and somewhat shrivelled, as it is imported into Europe. The ripe pepper shrivels less than the unripe, which often becomes mere dust. Its goodness is tried by rubbing it hard between the hands: if the pepper be sound, this produces little effect on it; but if it be injured in the drying, or unsound, it is readily reduced to powder.

White Pepper, as I have said, is the ripe and perfect berries stripped of the outer coat. The pepper is steeped in water for a fortnight, or until it swell and burst its tegument; from which it is afterwards separated by drying it in the sun,

* Woodville's Med. Bot. 3d ed. p. 721, pl. 216. London Dispensatory, art. Piper.

† Every species of this natural genus is imbued with aromatic principles, and used in some part of the world: Pepper, Cubebs, the Betel of the Malays, and the Kava of the South-sea Islanders, are Pipers.

and rubbing it between the hands. In India, the coat is removed from the undried fruit by means of a preparation of lime called *Chinam*.

The appearance of *Black Pepper* is well known: it is about the size of a small pea, covered with a dark brown, rough coat, which should not be too much shrivelled. It has an extremely pungent, biting taste, and a powerful aromatic odour. This pepper swells greatly when steeped in water. *White Pepper* is milder and less aromatic than the black; and it has this superiority, that it can be made only of the soundest and most mature fruit; and, consequently, it brings nearly double the price of the black. It was long supposed in Europe to be the production of a different plant.

The infusion or decoction of Black Pepper in water reddens the vegetable blues; which is owing to the presence of free malic and uric acids; the presence of the latter of which causes the decoction of Pepper to decompose the hydrosulphuret of potassa and to throw down its sulphur. In making the decoction of Black Pepper, a quantity of green acrid oil is separated during the boiling, which does not appear in making that of White Pepper. This is a fixed oil; for, in distilling the alcoholic tincture of Black Pepper, it remains in the retort. The decoctions of both Black and of White Pepper yield a flocculent precipitate with infusion of galls which dissolves again at a heat of 120°, and indicates the presence of starch; on which account the tincture of iodine strikes a blue colour with these decoctions. According to the analysis of Pelletier, Black Pepper contains—1. *piperina* (to be noticed in the class of Tonics); 2. a concrete, green, fixed, *acrid oil*; 3. a *volatile oil*, nearly colourless and lighter than water; 4. a *gummy, coloured substance*; 5. an *extractive principle*; 6. *starch*; 7. *bassorine*, a kind of gum resembling tragacanth; 8. *malic* and *uric acids*; some alkaline and earthy salts; and 9. *lignine*. I am of opinion, however, that we may regard it as composed chiefly of *piperina*, a *concrete, fixed, acrid oil, starch*, and the *malic* and *uric acids*. The decoction forms precipitates with solutions of most of the metallic salts, sulphate of iron, acetate of lead, bichloride of mercury.

b. LONG PEPPER. *Piperis Longi fructus.* L. E. D.—This is the fruit of a perennial, scandent shrub, the Piper *Longum*, a native of Hindostan, Nepaul, and Java*. The fruit is a condensed spike, about one inch in length, dry, firm, heavy, and of an obscure grey colour. Each little eminence contains a seed, red or blackish on the outside and white within. Like black pepper, it is gathered before it is fully ripe. The spike is prepared in its entire condition.

Long Pepper is less aromatic than Black Pepper; but equally hot to the taste and affording nearly the same constituents. The concrete acrid oil is even more pungent than that of the Black Pepper; at least the pungency is more permanent.

Decoction of Long Pepper is affected by the same tests as that of common Pepper. Ether digested on it takes up one part in four, and, when evaporated on the surface of water, leaves a resin impregnated with the pungent oil on which the smell and taste of the Pepper depend†. I conceive, therefore, that the addition of resin is the chief distinction between the components of Long Pepper and those of Black Pepper.

The effects of both these Peppers, as condiments and medicines, have been long known. They are mentioned by Celsus as external stimulants and suppuratives in many cases. The Black Pepper, deprived of its coat and put into a hollow tooth, is recommended as a remedy in toothache. The exciting effects of Pepper, internally administered, was also familiar to the ancients. Celsus noticed it as a diuretic; and, as early as the time of Xenophon, it was given to cocks to inspire them with courage in fighting: it was also employed, at an early period, as an aphrodisiac. Avicenna uses the term “libidinem concitat;” and, in some parts, it is still given to cows and mares with a similar intention.

As a medicinal agent, Pepper was long supposed to owe all

* See Woodville's Medical Botany, third edition, vol. iv, p. 724, pl. 247. London Dispensatory, art. Piper.

† The root of Piper *longum* possesses the virtues of the fruit in a weaker degree: it is employed by the native Hindostanee physicians in cases of palsy, tetanus, and apoplexy.

its medicinal qualities to the acrid oil which it contains; but, since the discovery of *piperina*, this opinion has been set aside: it is, nevertheless, still justly admitted, that the exciting properties of Pepper are solely due to the acrid fixed oil. This oil, when separated, is too pungent to be tasted with impunity, unless greatly diluted; and it is undoubtedly the most powerful of the vegetable Excitants. Applied to the skin, it reddens and inflames it; and thence we readily trace the cause of the sensation of almost insupportable, long-continued burning which it excites when taken into the stomach. Van Swieten mentions that he had witnessed a violent fever excited by an over-dose of Pepper. Besides increasing powerfully the action of the heart and arteries, the excitement is especially experienced, as I have already stated, in the sexual organs. Like all powerful medicines, however, Pepper is highly beneficial when administered in proper doses: it affords an agreeable stimulus to the nerves of the stomach, promotes the secretion of the gastric juice, and, consequently, aids digestion in weak stomachs.

Pepper, steeped in rum, is a well-known domestic remedy, among the poor, for the cure of intermittent fevers. It operates by exciting copious perspiration; but, when it does not arrest the rigors, and the hot stage supervenes, the fever is always more severe after the administration of Pepper: and the indiscreet use of the remedy has been productive of fatal consequences. Much depends on the state of the stomach at the time of using the remedy. Since the discovery of *piperina*, doubts have arisen whether the curative power of Pepper in intermittents is to be attributed to that principle or to the acrid oil. Few opportunities have occurred for trying the effect of perfectly pure *piperina*; and certainly the greater part of that which has been hitherto used has not been free from the acrid oil. The oil alone has cured intermittents; but M. Majendie asserts his belief that this is owing to its retaining some *piperina*: and this opinion finds some support from the fact that chamomile flowers, which contain no acrid oil, but contain *piperina*, cure intermittents. At all events, the exciting power of Pepper can only be justly ascribed to its acrid fixed oil.

Pepper may be administered in the entire state, two, four, or six of the Pepper corns at a time: or it may be given in the form of powder, to the amount of six, eight, or ten grains for a dose. Black Pepper is a component in two external preparations: an ointment ordered by the Dublin College, and the compound plaster of Cantharides of the Edinburgh Pharmacopœia. The Long Pepper forms a part of the confection of Opium, of the aromatic powder, the compound powder of Chalk, and the compound tincture of Cinnamon of the Pharmacopœia.

MUSTARD. *Sinapis Semina*. L. D. *Sinapis Albæ Semina*. E. D.—The first of these substances is the seed of the *Sinapis nigra*, a plant which grows wild in almost every part of the world, and is cultivated in many countries. The seeds of both it and its congener, reduced to flour, are well known condiments. Both plants are members of the natural order Cruciferae*.

The seeds of both species of *Sinapis* are small and globular; those of *S. nigra* have a dark-brown colour; those of *S. alba* are pale yellow. When bruised, they have a very pungent odour, although in the entire state they have scarcely any: their taste, when masticated or bruised, is acrid and biting. M. Thibierge has analyzed Mustard, and obtained from it the following products:—1. a soft, fixed oil, of a dark greenish-yellow colour, soluble in alcohol and ether, which is procured by pressure; 2. another oil, obtained by distillation, of a golden-yellow colour, volatile, heavier than water, having a hot acrid taste, soluble in alcohol, and depositing sulphur. It is this oil which irritates the eyes and excites tears, in mustard prepared for the table, and which vesicates when Mustard is applied to the skin; 3. an albuminous vegetable principle; 4. a large quantity of mucilage; 5. sulphur; 6. nitrogen; 7. the seeds, incinerated, appear to contain phosphate and sulphate of lime and a little silex†.

The fixed oil referred to in the foregoing analysis has a sweetish taste, and a slight nauseous odour; it is soluble in

* Woodville's Medical Botany, third ed. p. 403, pl. 146. London Dispensary, art. *Sinapis*.

† Journ. de Pharm. tom. v, p. 439.

32 parts of alcohol and 16 of ether, is lighter than water, having a specific gravity 0.8815; and, when boiled with litharge, is changed into a soft, yellow, transparent viscid substance, which dries like varnish. The seeds yield $\frac{1}{3}$ of their weight of this oil, which, in large doses, operates as a purgative. The marc, which remains after the pressing, is more pungent than the seeds previously were; and, on this account, the seeds are submitted to pressure previous to being formed into flour of mustard to be used as a condiment. By afterwards distilling the marc with as much water as will prevent empyreuma, some volatile oil is procured: its specific gravity is 1.0387. M. Guibourt supposes that this oil is not actually present in the seeds of Mustard, as bruised Mustard seeds exhale no odour until they are moistened: but the fact that a portion of the acrid principle is expressed with the fixed oil, is at variance with this opinion. If the seeds be triturated with lime, ammonia is exhaled, probably owing to some decomposition taking place, which yields hydrogen to combine with the nitrogen of the seeds. M. Henry and Garot have ascertained that Mustard contains a peculiar acid, which they have named sulphosinapic, in which sulphur is supposed to exist in a peculiar state of combination*.

Notwithstanding the stimulant property of mustard, it is astonishing how greatly the stomach resists its action. In moderate doses, as a condiment, Mustard is a wholesome Excitant to the stomach; in a weakened state of that organ, it rouses its sensibility, and promotes chymification: in large doses it interrupts digestion, and irritates the nervous system. Van Swieten relates the case of a strong healthy man, attacked with a quartan ague, who swallowed a large quantity of bruised mustard-seeds steeped in hollands: inflammatory fever followed and carried him off in three days†. In intermittent fevers, however, the union of the exciting influence of the Mustard with the tonic power of Cinchona has proved highly beneficial.

Callisen advises the combination of Mustard and Cinchona in the low stage of typhus‡: its utility is manifested by a

* Journ. de Chim. Med. t. i.

† Commentaries, vol. ii.

‡ Acta. Soc. Med. Hafn. t. i, p. 364.

gentle perspiration, an increased secretion of urine, and an abatement of delirium: occasionally, it causes vomiting.

As a local Excitant, the influence of Mustard is well known. Mingled with boiling water, and applied hot, as a cataplasm, the mixture excites the skin powerfully, causing redness, great heat in the part, and, ultimately, vesication. With the intention of causing revulsion, by exciting action in a distant part, Mustard cataplasms are applied to the soles of the feet in fevers with local determinations to the head or the stomach. Such cataplasms are also useful in cases of atonic gout affecting the stomach, the heart, or the diaphragm, and in apoplexy. In such cases they are preferable to blisters, from the promptness of their action. In cases where a less degree of excitement is requisite, the flour of Mustard is mixed with crumbs of bread softened with water. With the same intention, it is also added to the pediluvium. In some instances, the volatile oil of Mustard has been employed as a rubefacient.

PELLITORY ROOT. *Pyrethri Radix*. L. E. D.—In Pellitory root, the acrid principle is of a more fixed character than in Mustard; it is combined with inulin and gum.

Pellitory is the root of *Anthemis Pyrethrum*, a plant belonging to the same genus as the chamomile; and, consequently, a member of the natural order Compositæ. It is indigenous in the south of Europe, on the coast of Syria, and on that of Barbary*.

The roots, as imported into England, are in pieces of four or five inches in length, and about one-third of an inch in diameter, slightly curved, and of a dirty whitish grey-colour, breaking with a short resinous fracture. They are inodorous, and, at first, apparently insipid; but, soon afterwards, the taste is extremely pungent, not unlike a mixture of salt and acid, with a pricking or thrilling sensation on the tongue and lips, which excites powerfully, also, the excretory ducts of the salivary glands. In a longitudinal section of the root, a

* Woodville's Medical Botany, third edition, p. 50, pl. 20. London Dispensatory, art. Anthemis.

multitude of vesicular hollows may be perceived, in which the acrid fixed oil is deposited. According to the analysis of M. Gauthier, 100 parts of Pellitory root contain, of fixed acrid oil 5.0, yellow colouring matter 14.0, gum 11.0, inulin 33, muriate of lime a trace, lignine 35.0, and water 2.0*.

The acrid principle is readily extracted by ether; it is odorous, reddish, has a hot, acrid taste, exciting salivation, and resembling a mixture of resin and fixed oil. When it is taken up by ether, the rest of the substance of the root is left almost insipid.

Pellitory root is a powerful Excitant; but its employment is confined to cases in which a local stimulus is necessary, as in paralysis of the tongue, and of the internal organs of deglutition, arising from circumstances affecting, partially only, the nerves of these organs. It is chewed, in a more or less bruised state, according to the power of mastication enjoyed by the patient.

d. BITTER EXTRACTIVE.

CONTRAYERVA ROOT. *Contrajervæ Radix*.—The plant, of which this is the root, the *Dorstenia Contrajerva*, belongs to the natural order Monimieæ†. It is a native of Peru, Mexico, and the West Indies. It was first known as an antidote against the bites of serpents, and is still used as such in Brazil, whence the name *Contrahierba*, the Spanish for antidote. The root is an irregular tubercular substance, covered with scales on its upper part, and furnished with slender fibrils on its lower part: the plant is unimportant, consisting simply of four large, petiolated, pinnatifid leaves; but it is furnished with a singular floral receptacle, of a square shape, in which the flowers are placed in kinds of alveoli; and, as they are male and female, the plant is supposed by some to be, properly, monœceous.

Contrayerva root, in its dried state, is long, of a reddish-brown hue, and curved at the point; it has a peculiar, not dis-

* Journ. de Pharm. 1818, p. 33.

† Woodville's Medical Botany, third edition, p. 705, pl. 240. London Dispensatory, art. *Dorstenia*.

agreeable, aromatic odour; and a warm, bitterish taste, leaving an impression on the tongue which does not soon leave it. Its infusion does not affect the protosulphate of iron. The watery decoction of the root is extremely mucilaginous, owing to the great quantity of fecula it contains; on which account, it is requisite to add chalk or some dry material in powdering the root.

Contrayerva root was at one time highly esteemed as a stimulant in the low stage of typhoid fevers: but, like many things too highly extolled, it lost its credit, and has been as undeservedly neglected as it was improperly vaunted. When taken into the stomach it quickens the general circulation, and augments the appetite and the powers of the stomach; on which, and from some mistaken notions regarding its powers as an antiseptic, arose its high character as an Excitant. In conjunction with cretaceous powders (*Pulvis Contrayervæ compositus*. L.) it is found to be useful in those complaints of children in which the skin does not act, from a langour of the heart and circulating organs; and, while its bitter aromatic principle stimulates moderately, the mucilaginous matter of the root involves the acid of the stomach, at the same time that the energy of the organ is augmented. The dose of the powdered root is from gr. xv to ʒi.

e. STRYCHNIA.

This Alkaline substance, which was discovered by Pelletier and Caventau in 1818*, is prepared by the hand of Nature, in the fruit of the *Strychnos Nux vomica*, *S. Ignatia*, and of some other plants of the same genus. It exists in combination with a peculiar acid, the Igasuric. One pound of seeds of *Nux Vomica*, well managed, should yield 34 grains of pure Strychnia; the same quantity of the Bean of St. Ignatius, properly treated, should yield 102 grains.

The *S. nux vomica* is the officinal plant of the British Pharmacopœia. It is a magnificent tree, a member of the natural order Apocynææ, a native of the islands of the Indian

* Mem. Sur. un Nouv. alkali veget. trouvé dans la fève de Saint Ignace, &c. &c.

Archipelago, of the coast of Coromandel, Cochin China, and several other parts of the East Indies, where it is known by the name of *Caniram*. The seeds from which the Strychnia is procured are flattish, depressed in the centre on one side and convex on the other; covered on both sides with a velvety down, and containing a horny, semi-transparent perisperm, which encloses an embryo with two cotyledons.*

All the parts of *S. nux vomica* are extremely bitter; and, more or less, contain Strychnia; but it is from the seeds that this active principle has been extracted. Besides the Strychnia which these seeds contain, in the form of an *Igasuriate*, their other components are—2. a yellow colouring matter; 3. a concrete oil; 4. gum; 5. starch; 6. a small proportion of wax; 7. bassorine; and 8. lignine. They yield their active principle to boiling water, but much more abundantly to alcohol. The decoction is precipitated greenish by subacetate of lead; green by the sulphates of iron; pea-green by sulphate of copper; and opaline by infusion of gall-nuts. This precipitate, which is again dissolved at a temperature of 120° Fahrenheit, is a tannate of starch. There are various methods of obtaining the Strychnia. The simplest, but not the most economical, is to macerate the rasped seeds in ether, in close vessels, in order to take up the wax and the concrete oil; the marc is then to be acted on repeatedly with boiling alcohol, which is afterwards to be distilled in close vessels; a yellowish-brown coloured extract is left, which is to be boiled with pure magnesia in excess, then washed and dried. The *Igasuriate* of Strychnia is thus decomposed, and the Strychnia, which is nearly insoluble, precipitates with the magnesia. This compound of magnesia and Strychnia is lastly to be boiled in strong alcohol, and the Strychnia obtained by crystallization. It is, however, seldom procured in a pure state by this process, for it generally contains some *Brucia*, which is rendered evident when a blood-red colour is communicated to the salt by nitric acid. This species of Strychnos contains two distinct

* See Woodville's Med. Bot. 3d edit. p. 222, pl. 79. London Dispensatory, art. Strychnos.

active principles, *Strychnia* and *Brucia*; both of which are in combination with Igasuric acid.

Strychnia is procured also by precipitating a strong decoction of the seeds with acetate of lead, which leaves the Strychnia and Brucia in solution as acetates, mixed with some undecomposed acetate of lead; but this can be easily separated by sulphuretted hydrogen gas, which throws down the lead in the form of a sulphuret. The fluid is next to be filtered, and boiled to expel the superabundant sulphuretted hydrogen, and magnesia then added in excess: this decomposes the acetates of Strychnia and of Brucia, and forms a soluble acetate of magnesia, whilst the excess of magnesia carries down with it nearly insoluble Strychnia and Brucia. This precipitate is next to be well washed with cold water, and, when nearly dry, to be treated with boiling alcohol to separate the Strychnia. The alcoholic solution, filtered whilst boiling-hot, is next to be evaporated to dryness, and the extract macerated in weak alcohol, which dissolves the Brucia and colouring matter, and leaves the Strychnia in a pure state, but not crystallized. By re-dissolving the impure Strychnia in boiling alcohol and leaving it at rest to cool, the alkaloid is procured crystallized in its pure state. When pure, it exists in the form of minute, elongated, tetrahedral, prismatic crystals, terminated by a pyramid: but, when it is rapidly crystallized, it is in a granular form. It is inodorous, and has so very intense a bitter taste, that one grain of it gives a perceptible bitterness to eighty pounds of water. Like the other vegetable alkaloids, Strychnia is scarcely soluble in water, requiring 6667 parts of that fluid, at 50° Fahrenheit, for its solution, and 2500 parts of boiling water. It is not very soluble in ether and in cold alcohol; but is very soluble in boiling alcohol, and in volatile oil at 60°. Strychnia is unalterable in the air; but, when exposed to heat, it is decomposed, swells, becomes black, and furnishes ammoniacal products. It is seldom procured free from Brucia; but this may be removed by maceration in dilute alcohol. Its purity is easily known by testing it with nitric acid, which colours it red if Brucia be present. If it is required to ascertain the quantity of Brucia,

the specimen of Strychnia must be mixed with hot water in a glass tube, and any acid added until the solution be complete; the solution is then to be boiled, and, whilst it is boiling, the Strychnia precipitated with ammonia. If the Strychnia be pure, the precipitate will be pulverulent; if it contain Brucia, it will adhere to the sides of the tube. By weighing the tube before the experiment, and after the powdery precipitate is washed out of it, the quantity of Brucia thus adhering is indicated by the excess of weight.

Like the other vegetable alkaloids, Strychnia combines with acids, forming crystallizable soluble salts. In the natural state in which it exists in *Nux Vomica*, and the bean of *St. Ignatius*, it is united, as already stated, with a peculiar acid, which M. Pelletier and Caventau have proposed to call *Igasuric*. When obtained in a separate state, this acid is characterized by precipitating ammoniaco-sulphate of copper green. The salts of Strychnia are precipitated white by oxalates and gallates of alkalies; as, for instance, the oxalate of ammonia, and the gallate of potassa.

Besides combining with acids, Strychnia unites with iodine, forming very important compounds in a medicinal point of view.

According to the experiments of Pelletier, and those of Henry and Plisson, Strychnia is an azotized product, consisting of—

	Pelletier and Dumas.	Henry and Plisson.
Carbon . . .	78.22 . . .	76.40
Azote . . .	8.92 . . .	7.50
Hydrogen . . .	6.54 . . .	7.87
Oxygen . . .	6.32 . . .	8.23
	100.00	100.00

The *Igasuriate*, as it exists in the plants which contain it, consists of three atoms of Strychnia and two atoms of acid; and the same proportions enter into all its salts.

There can be only one opinion, that the *Igasuriate* of Strychnia is the active principle of *Nux Vomica*: the following remarks, therefore, may be regarded as applicable to

Strychnia, both in its combined state in *Nux Vomica*, and in its separate or pure state.

Strychnia in all its forms, pure or combined, is a powerful Excitant, displaying its influence, first by an increased energy of the whole system; and next, chiefly on those tracts of the *Medulla spinalis* which give origin to the motor nerves. The nerves of sensation, however, are also involved in its action; for, along with the muscular contractions and convulsions which supervene, the surface of the body is so morbidly sensitive as to be susceptible of the slightest impressions; even the motion of the air becomes a source of uneasiness, nearly as considerable as in hydrophobic cases*. Before any twitchings or tetanic convulsions, also, are excited during the ad-

* This effect on the nerves of sensation is most remarkably displayed in reptiles; and, as it was particularly demonstrated in the following experiments, I trust I shall be excused for inserting them in this note.

May 30, 1832.—An incision was made near the spine of an ordinary green snake, about eight inches from the tail, and one grain of powdered Strychnia rubbed into the wound. The part oozed out only a little blood. The reptile was strong and lively. For nearly an hour afterwards it seemed little disturbed; but, after that time, it became extremely irritable; hissing and rearing itself as if about to strike at any one who attempted to touch it, and moving about with a restless, anxious movement. In three hours it became irregularly convulsed four or five inches above and below the wounded part: it then lay still, except on being touched, when the convulsions were immediately renewed. At the termination of eight hours, the tail had become nearly insensible; and, even when pinched severely, scarcely moved: the greater part of the body was also now insensible. The head and neck, to the extent of ten inches, remained morbidly sensitive; and, for four hours, this sensibility was so great that the convulsions which affected the head and neck were excited by merely blowing the breath upon the animal or agitating the air near it. Dr. Marshall Hall, who witnessed this part of the experiment, satisfied himself of this effect of agitating the air by interposing a pane of glass between the animal and his mouth, and then blowing upon it: no convulsions supervened. The slightest noise also caused a renewal of the convulsions. At this time the head and neck were convulsed every minute; the convulsions continuing for the space of fifteen seconds, then ceasing for four or five seconds, and again recurring for three successive times; after which the animal would remain still for the remainder of the minute. These convulsions were preceded by a sudden expiratory effort, expressed by a low, hissing sound, which continued for three or four seconds; when the head was raised from the ground, and rapidly moved in a lateral direction. At the termination of twelve hours from the insertion of the Strychnia, the convulsions became less frequent, recurring only once in several minutes; but the sensibility was still morbidly acute.

May 31.—The upper part of the body was now very languid; and convulsions

ministration of *Nux Vomica* and of *Strychnia*, sensations of heat, prickings, formications, and other uncomfortable feelings, are felt in the limbs. Neither these sensations nor the irregular muscular actions proceed with an unvarying intensity; they increase at one moment, and subside in the next, keeping pace, as it were, with the changes which supervene in the power of the irritations impressed on the medullary matter of the spinal cord. Let us take a brief view of the effects of this Excitant on the different organs which are within the sphere of its influence.

On the stomach, the first obvious effects of the administration of *Strychnia*, in any form, is an increased energy in the digestive powers; the appetite improves, assimilation is better effected, and the person becomes fat, more healthy in appearance, and stronger. Although circulation is not perceptibly affected, yet the respiration soon becomes oppressed, the respiratory muscles seem to suffer a clonic contraction, and, when the dose is augmented, the person feels as if about to be suffocated. The urinary organs are little influenced; but the cutaneous system, besides the increased susceptibility of impression already noticed, has its capillary vessels

occurred only when the reptile was touched: the tail had, however, recovered its sensibility, and moved briskly when touched near the spot where the *Strychnia* was inserted.

June 1.—Every thing continued nearly in the same state as yesterday. Wishing, therefore, to shorten the sufferings of the animal, a quarter of a grain of pure *Strychnia* was introduced about four inches from the head. Soon afterwards, the irritability and liveliness of the reptile returned; but, after an hour, it gradually subsided; and, on the following day, the snake was found firmly coiled up and apparently dead in every part. On the following day, however, the animal was still alive at the head; but the tail and the body had been perfectly dead, from the tip of the tail upwards, for the last twenty-four hours. The head and about six inches of the body moved; but the lower part of it was completely motionless. On the following morning, June 4th, the snake was found completely dead.

The same morbid susceptibility of the surface was observed in experiments on three frogs, a toad, and two newts. For some time, the influence of the poison was manifested only on the side of the reptiles into which it was inserted. In the newts, the wounded side was completely dead, whilst the animal was yet able to swim with the other side. How far this effect is to be ascribed to some peculiar disposition of the nervous system in these reptiles, I am not prepared to decide.

also powerfully excited, and copious perspirations occur during the operation of Strychnia.

Such are the effects produced in the healthy system ; before noticing the therapeutic employment of Strychnia, it may prove useful to take a slight view of the effects which it has produced upon the lower animals : for, by having a complete knowledge of the power of any medicinal agent, when the dose is carried to its utmost limits, we are enabled to reason more correctly upon its effects, and to evade errors in practice which could only be learned after events that are always to be regretted have occurred, and which might be prevented by studying the effects of the medicine upon quadrupeds.

When dogs swallow from twenty to thirty grains of powdered *Nux Vomica*, they are quickly attacked with all the symptoms of tetanus, distension of the limbs, tremors, convulsive movements of the face and eyelids ; immobility of the eyes, and a complete rigidity of all the muscles of the body. There is an involuntary emission of urine. While life continues, the convulsions are renewed by sudden noise or the slightest touch ; but during the whole of the time there is no delirium ; and, if we may speak of the mind of a dog, the mental faculties remain entire. In the same manner, many other animals, cats, rats, foxes, and some birds, are affected : but some animals—hogs, for example, and goats—eat the *Nux Vomica* with impunity. M. Desportes also found that it produces very little effect upon poultry. He fed a hen with it until an ounce and forty grains were taken, and yet no effect was produced on the fowl. On the tenth day the dose was carried to thirty grains, and, two days afterwards, to sixty grains, without any hurtful result. From the fourteenth day to the nineteenth, the doses were increased to one hundred and twenty grains : it then caused rigidity of the limbs, purging, and a great distension of the crop. On the twentieth day, four grains of the extract were given to the hen, and, three hours afterwards, one hundred and sixty-four grains of the bruised seed, when the animal died in a state of tetanic rigidity.

Many experiments of this nature were made by Desportes, Delile, and Majendie. They also applied the *Nux Vomica*

and its extract to wounds, and to mucous and serous surfaces. M. Delile injected a solution of twelve grains of the extract into the pleura of a dog: tetanus supervened in less than a minute, and the animal soon died. Applied to wounds, it produced the same effect: but no convulsions followed when it was applied to the sound skin. M. Delile prepared an extract, by macerating the bruised seeds in alcohol, then evaporating it, and removing the gummy principle by water. One grain and a half of this resinous extract were smeared on a small piece of wood, and a dog wounded with it in the thighs: tetanus supervened in seven minutes, and proved mortal in five minutes after the first attack. Introducing the watery decoction of *Nux Vomica* into the circulation, by injecting it into the jugular vein, produced immediate tetanic symptoms, which rapidly proved fatal. Post mortem examinations did not display any inflammatory appearances in the stomach; yet the poison has always been found in the stomach or the duodenum. One appearance, however, invariably presents itself, whatever may be the surface to which the poison is applied: that is, there is a general contraction of the whole arterial system, which is so obvious in the large vessels, that, in my experiments with *Strychnia*, I always found the aorta of a strong dog reduced in diameter to the size of a crow quill. I have, also, always found black blood in all the arterial cavities. On these grounds, M. Delile and M. Majendie maintain that the effect is not communicated through the nervous system, but that the poison is absorbed and conveyed by the blood to the spinal column, on the anterior nerves of which its immediate influence appears to be exerted. There is much plausibility in this reasoning; but, from the effects of *Nux Vomica* on the stomach itself—for, when it is given in small doses, no tetanic effects are produced—and also from the effect of the Tincture of Iodine, the antidote which has been lately discovered, and which acts by changing the nature of the poison as it exists in the stomach (for we cannot suppose that the change induced, which is of a chemical nature, is likely to take place after the poison has been absorbed)—I cannot accord with the theory of its

operation proposed by these able physiologists. In addition to these facts, we also know that the effect of the poison is suddenly checked if the stomach can be emptied by a powerful emetic; and, consequently, as its influence can be as readily explained by the supposition of its primary effects on the nerves of the stomach as by absorption, I must continue to believe that the active principle of this vegetable production operates solely through the intestinal nerves, until more decisive proofs be afforded of its absorption into the blood.

That Strychnia acts, when given in too large doses, directly upon the origin of the motor nerves is evident; first, from the nature of the symptoms that follow—for instance, violent tetanic convulsions, rigidity of the voluntary muscles, as well as those of respiration, thence immobility of the chest, and consequently the deficiency of the decarbonization of the blood; and, secondly, from the evidence afforded by an experiment of Fœderé, who found that, on exposing the spinal marrow in an animal to which Strychnia had been given, he could arrest the convulsions by pressure on the anterior segment of the spinal cord. Experiments have also ascertained the fact, that Strychnia produces no effect upon the system when the spinal marrow has been previously destroyed.

Strychnia produces the same effect on man as on quadrupeds. This fact is of importance in two points of view: it leads us to be guarded in the administration of this substance, when its exciting influence only is required; and it enables us to take advantage of even its deleterious properties, and to turn them to account in the cure of diseases. In doses from grs. ss to grs. iv of the Extract of Nux Vomica, prepared according to the formula of the Dublin College, it produces some degree of nausea, a sensation of weight at the epigastrium, occasionally colic, and irritation at the anus. These symptoms are followed by weight in the head, giddiness, pain of the eyes, a sensation and pricking in the urethra, prostration of strength, and apathy; and if the dose be carried beyond grs. iv, tetanic convulsions supervene.

Accidents, and a variety of circumstances, evidently affecting the spinal marrow, early demonstrated the fact that paralysis of the lower extremities may occur without any

affection of the brain; and led pathologists to refer this disease, under all circumstances of its occurrence, to some morbid change, or impression on the motor tract of the spinal cord. It is not necessary, for our purpose, to enter into a discussion of the argument whether it is ever produced by diseased impressions on the brain itself; an opinion which was entertained by Dr. Baillie and Sir James Earle, and is still maintained by several distinguished physicians; and which, if it be correct, does not affect our position, that some morbid change or impression on the anterior portion of the spinal cord is the most general cause of Paraplegia, or palsy of the lower extremities. It is often induced by powerful sedative impressions on the extremities of the nerves supplied by the intestinal canal, as in painter's Colic produced by the carbonate of lead taken into the stomach; and, as this is cured by Strychnia, it affords another proof of the truth of my opinion, that Strychnia operates through the medium of the intestinal nerves. Supposing Paraplegia, therefore, to depend on a paralysis of the anterior nerves of the spine, and knowing the influence of Nux Vomica on this set of nerves, Dr. Fouquier, of the Hospital de la Charité in Paris, was induced to try its effects as a remedial agent in this disease. He administered it both in the form of powder and that of extract, with decided advantage. In the dose of grs. ii of the extract, it sometimes produced contractions in the paralysed muscles, more or less permanent: sometimes these were sudden and transient; at other times they were more slowly induced, and several doses of the extract were required; but a more permanent effect was the result. It is a curious fact, first remarked by M. Fouquier, that the paralytic parts appear always more sensible to the action of Nux Vomica than the sound parts.

The success of M. Fouquier's treatment induced other physicians to try the redemy in different parts of Europe; and, from the whole of the experience recorded, although mischievous effects have occasionally resulted from its injudicious and indiscreet employment, yet, there is ample authority for regarding it as a most valuable Excitant in palsy of the lower extremities. As far as my own experience au-

thorizes me to form any conclusions on this subject, I am disposed to regard Strychnia, or the Extract of Nux Vomica, most useful in those cases of palsy that proceed from sedative impressions on the intestinal nerves; such, for example, as occur when carbonate of lead, taken into the stomach, produces Colica pictonum; and, indeed, in every case of palsy of the motor nerves only, which is readily known by the sensibility of the paralytic limb remaining after the power of motion is lost, and by the entire state of the sensorium commune.

I have hitherto spoken of the action of Strychnia and Extract of Nux Vomica as the same; but they differ in one respect, which is not easily explained. Extract of Nux Vomica determines powerfully to the head: on the other hand, pure Strychnia, or its salts, produces scarcely any obvious effect on the cerebral circulation; a fact of great practical importance, as it authorizes us to prescribe Strychnia and its salts in cases where, although paralysis may have arisen from pressure in the brain, yet, there is reason for thinking that benefit may be derived from the influence of so powerful and direct an Excitant on the nervous system. In cases, however, in which a striking plethoric state exists, the previous use of the lancet is requisite, to prevent an over-distension of the venous system likely to result from the powerful contractile influence of the Strychnia on the coats of the arteries. In very few of the cases which have come under my observation has the administration of pure Strychnia, or its salts, been followed by headache; with the exception of one case, in which symptoms closely resembling those of intoxication supervened on the third day after commencing the use of the remedy, which was repeatedly discontinued, and when renewed was always attended with a return of this effect. I am disposed to regard this as an instance of idiosyncrasy, rather than a result of the medicine likely to occur in others.

From these facts, there is every reason for preferring pure Strychnia, or its salts, to either the powder or the Extract of Nux Vomica. Various causes, also, may occur to render the powder or the Extract uncertain in its operation; whereas the proper apportioning of the dose of Strychnia to the con-

dition of the patient, and the severity of the case, must always afford a more certain result than we can expect from it when clogged with other vegetable constituents, as in the powder and the Extract.

With respect to the mode of prescribing Strychnia, it is necessary to bear in remembrance its great insolubility, and the variation of activity of the salt according to the acescent state of the stomach at the time. The greater the quantity of acid which is present in the stomach, the more active will the Strychnia prove. To obviate this inconvenience, it may be administered in the form of acetate, which is easily produced by dissolving one grain of pure Strychnia in fʒi of distilled vinegar, so that six minims of this solution contain one tenth of a grain of Strychnia, the dose of the medicine which should be given at first. Such a solution, also, enables the dose to be more gradually increased than can be effected when the medicine is in the state of powder. The extent of the dose to which it has been carried in some instances, can only be explained by the little solubility of the medicine, and the defect of acid in the stomach of the patient. Given in the form of the acetate, I have in no instance been able to carry the dose to the extent to which Dr. Bardsley has carried it: indeed, I have never been able to exceed thirty minims of the solution, a dose equivalent to half a grain of the Strychnia, three times a day. The usual forms of giving Strychnia are those proposed by M. Majendie. He directs grs. ii of the pure salt to be carefully beat up with grs. xxx of conserve of roses, and divided into twenty-four pills, each of which should thus contain one twelfth of a grain of Strychnia. He also orders it in the form of tincture, composed of grs. iii of pure Strychnia dissolved in fʒiss of strong alcohol, so that three minims of the solution contain one tenth of a grain of the salt. The sulphate has, also, been occasionally employed.

The Nux Vomica, when administered in the form of powder, has been carried to the extent of fifty grains a day. Of the alcoholic Extract, two grains are at first given at night and in the morning; and one grain is added every day, or every second day, until the specific influence of the remedy displays itself with an intensity sufficient to lead to a salutary result.

The following case is one among many which might be selected to illustrate the action of Strychnia in paralysis.

Mrs. R. a widow lady, aged seventy, of a spare habit, and delicate frame of body, was attacked, in November 1830, with hemiplegia of the right side of the body. She was attended by a respectable general practitioner, by whom she had been very judiciously treated prior to my advice being requested. I found that Mrs. R. had lost the power of motion in the whole of the right side of the body; the mouth was drawn to the opposite side of the face; the upper eye-lid on the affected side was depressed; and the articulation was so much impeded, that her answers to my questions were scarcely intelligible. The sensibility, however, of the paralyzed side was entire, and its temperature not lowered; the pulse was quick, but feeble; and although the bowels were torpid, yet, they answered to the stimulus of purgatives; whilst the bladder performed, naturally, all its functions. After freely evacuating the bowels, the acetate of Strychnia was prescribed, in doses of one sixteenth of a grain to be continued at intervals of six hours, and the dose gradually increased until it amounted to a quarter of a grain. In a few days after the administration of the acetate had been commenced, the patient regained the power of raising the arm at the shoulder joint; in ten days she could move the affected leg; the drawing of the mouth disappeared in this time, and she articulated her words distinctly: in three weeks she could use the fingers of the paralyzed hand: and, in another week, she was able to walk about the room with the assistance of a servant. After the tetanic convulsions occurred, and the medicine was discontinued, she improved so rapidly that she was able, before the end of December, to get into her drawing room; and, before February the 21st, 1831, she walked out, and had nearly as much voluntary power over the muscles of the affected side as she ever enjoyed.

Strychnia, its salts, and the Extract of *Nux Vomica*, besides proving useful in ordinary paralysis, have been found beneficial in many other varieties of the disease. Thus the Extract of *Nux Vomica* may be advantageously given in rheumatic paralysis, in doses of half a grain every night and morning, until

three grains are taken for a dose. The result is, as usual, involuntary movements attended with pain ; but, on these ceasing, the power of volition generally returns by degrees to the limb affected, and the patient is able to walk in three or four weeks. It must, however, be acknowledged, that Strychnia has failed in many cases of this description, and that even although it has frequently greatly relieved cases of hemiplegia, yet it has not always succeeded in completely restoring the lost power of the affected side.

M. Frisch, a German physician, has affirmed that, in robust persons who are attacked with ague, when the sulphate of quinia fails, it may be rendered efficient by combining it with *Nux Vomica*. He prescribes from six to ten grains of the rasped seed, mixed with two ounces of cinchona bark, or twelve grains of sulphate of quinia, to be taken in divided doses in the intervals of the paroxysms. Dr. Bardsley supposes that it may prove useful in amenorrhœa ; and he has detailed several cases in which its administration was followed by the reappearance of the catamenia in its natural state. Dr. Bardsley ascribes this effect “to the power which the Strychnia possesses of stimulating the vessels of the uterus, and of improving the tone and vigour of the system*.” This theory of the beneficial influence of this Excitant in amenorrhœa is not perfectly satisfactory. If the flow of the catamenia is to be regarded as a secretion, an ample supply of arterial blood to the organ must be requisite for the due performance of its functions ; an effect not likely to result from the use of Strychnia. At the same time, whatever improves the tone and vigour of the system, must necessarily aid the functions of the uterine organs ; and, consequently, we are constrained to admit this view of its influence in effecting the cure of amenorrhœa.

The exciting power of Strychnia, in changing morbid into healthy action in the digestive organs, is well illustrated by its effects in pyrosis, a painful affection of the stomach, accompanied with a copious discharge of watery fluid by the mouth. It has also proved useful in chronic diarrhœa and dysentery ;

* Hospital Facts and Observations, &c. by James Lomax Bardsley, M.D. p. 57.

but its efficacy depends on the period of the disease in which it is administered. If given early, and during the continuance of inflammatory action, it is always injurious; but, on the decline of the inflammatory symptoms, by changing the action of the diseased surface, it removes the irritability of the intestinal canal and increases the powers of the digestive organs. M. Frisch asserts that no medicine is so efficacious as *Nux Vomica* in that form of chronic diarrhœa which is kept up by a subacute state of inflammation of the villous coat of the intestines, and which is marked by viscid mucous evacuations and considerable tenesmus. In this complaint, he combines it with small doses of ammonia and mucilaginous drinks, particularly salap.

With respect to the effects of an overdose of either *Strychnia* or of the extract of *Nux Vomica*, the fatal consequences seem to proceed chiefly from the poison exhausting the irritability of the heart. When it operates as a poison, the first effect is tremor: this is followed by stupor and a sense of intoxication, which is quickly succeeded by general symptoms of tetanus, stiffness of the muscles of the neck, lock-jaw, severe pain under the ensiform cartilage, violent spasmodic action in the lumbar muscles and those of the whole spine, so as to produce opisthotonos and laborious respiration, complete asphyxia, and death. As in all cases of poisoning the first object is to get rid of the offending cause, the second to destroy the virulence of the poison, the use of the stomach-pump or emetics must be resorted to as quickly as possible; after which tincture of iodine should be freely administered. This antidote was discovered by M. Donné, who found that the ioduret of *Strychnia* could be given in doses of gr. iiss to a dog with impunity; whereas gr. ss of *Strychnia* was sufficient to kill the animal. He therefore tried iodine as a counterpoison, and gave the tincture of iodine to dogs to which a grain of *Strychnia* had been given. In seven cases, one case only resisted the antidote; and in this it was not administered until ten minutes after the poison had been swallowed.

I have had no opportunity of trying this antidote on man, except in one case in which the tetanic symptoms arising from

the employment of Strychnia, in a case of paraplegia, were very alarming. The spasms certainly appeared to abate more rapidly than usual; but I cannot positively refer this effect to the use of the iodine. I am not aware of any instance of its beneficial influence in poisoning by Nux Vomica or by Strychnia in the human species being on record. Its influence, however, in this respect, in quadrupeds, is a strong reason for trying it in man.

When death has been the consequence of an overdose of Strychnia, the post mortem examinations have displayed scarcely any traces of inflammation even in the stomach; but the venous system of vessels is always gorged with blood, whilst the arterial is nearly empty.

ALCOHOL.—Syn. *Rectified Spirit of Wine.*

Alcohol is a powerful and most valuable Excitant, both in its *combined* and *uncombined* state. As we must examine it in both states, we shall understand it better if we first obtain a correct knowledge of it in its purest form.

Alcohol in its purest state, that which is supposed to be quite free from water, *absolute Alcohol*, has a specific gravity of 0.796, at a temperature of 60° Faht. It is a limpid, colourless liquid, of an agreeable, peculiar odour, and a hot, penetrating taste; its fluidity resists every degree of temperature above 110° Faht.; at which degree Mr. Hutton, of Edinburgh, is stated to have frozen it, in 1813: but there is, nevertheless, still reason for believing that the fluidity of absolute alcohol resists every known degree of cold, both artificial and natural. Pure alcohol is extremely volatile, rapidly evaporating, and producing great cold during its evaporation. It is highly inflammable, its vapour catching fire on the approach of any ignited body, and generating a large quantity of water and carbonic acid. The bluer the colour of the flame, the stronger the alcohol is accounted. Absolute alcohol boils, in the open air, at 168° Faht. and in vacuo at 56°. It has a great affinity for water, attracting it from the atmosphere, and mixing with it in every proportion. During its admixture with water, heat is evolved, owing to the density of the mixed fluids, being greater than the mean of the densities

of the unmixed fluids : the caloric is expelled from the interstices of the fluid, and consequently becomes sensible. Thus, if alcohol at 792 and water, in equal proportions, be mixed together, the sp. gr. will be 917 ; but the mean density would indicate only 896. According to Theodore Saussure, pure or anhydrous alcohol consists of—

Carbon	. 51.98	or 2 equivalents	$(6 \times 2) = 12$
Hydrogen	. 13.70	3 equivalents	$(1 \times 3) = 3$
Oxygen	. 34.32	1 equivalent	. . . = 8
			= 23
			100.00

or 2 equivalents of Carburetted Hydrogen $(7 \times 2) = 14$, + 1 equivalent of water = 9 ; = 23. Alcohol, even when less pure than this, is a solvent of many substances—camphor, resins, balsam, volatile oils, castor oil, sugar, manna, the vegetable alkaloids, and many other vegetable constituents :—it is therefore much used as a pharmaceutical agent. The alcohol employed by the directions of the London Pharmacopœia is of sp. gr. 815, and contains 93 parts of anhydrous alcohol and 7 parts of water.

Strong alcohol is prepared from weaker alcohol, by adding to it substances which have a stronger affinity for water than alcohol has. These substances are chiefly the deliquescent salts, such as muriate of lime, acetate of potassa, effloresced sulphate of soda, subcarbonate of potassa, and lime. The most economical and the best of these substances is the muriate of lime, or rather chloride of calcium. This substance is exposed to heat sufficiently great to drive off all the water it contains : it is put into a retort in small pieces, and the alcohol of commerce poured over it, in the proportion of ℥ii for every ℔i of the chloride. The mixture is then left at rest for some time, and afterwards distilled, removing the product at different periods ; the strongest being that which comes over first, and each portion becoming weaker towards the conclusion of the process ; until, at length, by pushing the distillation to dryness, little more than water is obtained. This process was invented by Richter.

Various means have been contrived to determine the quantity of water contained in different specimens of alcohol : all

of them are founded on the same principle, the relative specific gravity of the spirit at a given temperature. The hydrometer of Beaumé is one of the most convenient instruments for ascertaining this point.

Such is alcohol in its uncombined state. I shall defer noticing its effects on the living system, and its therapeutical uses, until I have examined it in its combined state.

Alcohol exists in a combined state in *Ardent Spirits*, or, in ordinary language, *Spirits*; combinations of alcohol and water, flavoured by volatile oils, on the nature of which the varieties of *Spirits* depend.

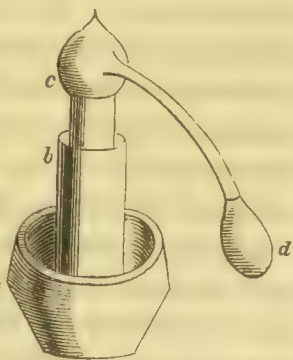
Every vegetable substance which contains sugar, gum, fecula, or similar principles, when diluted with water and exposed to a certain temperature, undergoes fermentation; during which the ultimate components of these principles enter into new combinations, the result of which is the formation of alcohol. To separate the spirit from the water and other ingredients, the whole is boiled in close vessels, and the vapour condensed; so that the alcohol, which is more volatile than the other ingredients, is obtained in combination with a small portion of essential or volatile oil, and some water. This process is termed distillation; and by the repetition of it, at a lower temperature, the alcohol is freed from another portion of the water, and then constitutes ardent spirits, which are named Arrack, Brandy, Geneva, Rum, Whiskey, Koumis, and so on, according to circumstances; but all of which are merely modifications of alcohol and water, tinged by some colouring matter, and flavoured by some essential oil. When the nature of these compounds was less understood than it has been of late, it was generally supposed that the alcohol was the product of the fermentation, and merely separated by the distillation: but Fourcroy originated an opinion, which was supported by some other chemists, that the alcohol is the product of the distillation. The experiments of Mr. Brande* and of Gay-Lussac† soon pointed out the fallacy of this opinion. Into wine a quantity of acetate of lead, or of litharge, in fine powder, was introduced, and the mixture agitated until the

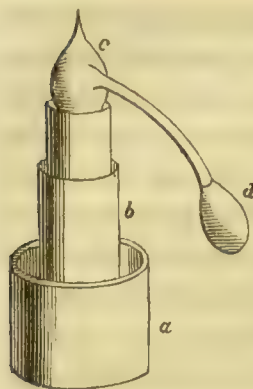
* Phil. Trans. 1811, 1813.

† Mem d'Arcencill. vol. ii.

colour nearly disappeared ; after which it was filtered : the colouring matter remained in the filter. Dry and hot carbonate of potassa was then put into the filtered fluid : the liquor divided into two distinct portions, which could easily be separated from one another by decantation. One of these, on examination, was found to be alcohol ; thus demonstrating the fact, that alcohol is ready formed in vinous or fermented liquors, and merely separated by distillation from a large portion of the water with which it is combined.

It does not appear that the process of distillation was known to the Hebrews, or any very ancient people ; nor was it known to the Greeks, who, amidst the effulgence of genius which brightened the best period of their history, were utterly ignorant of chemistry. Even the essential oil of pitch, which was collected by them, was procured by spreading the fleece of a sheep over the pot in which the pitch was boiled, and afterwards wringing out the oil collected in the wool. They procured fresh water at sea by suspending large sponges in the mouths of brazen vessels in which the salt water was boiled, and, when the sponges were saturated, they squeezed out the fresh water. This certainly may be regarded as a species of distillation in its rudest state ; but it was not until the time of Geber, who lived in the seventh century, that any process which may be justly called *distillation* was known. In the second book of his work entitled “ *Liber Investigationis Magisterii*,” some very accurate ideas of distillation are given, with figures of the apparatus. These are seen in the marginal cuts, which display the rude state of the apparatus, but demonstrate that the nature of the process was understood. *b* is the body of the still, *c* the capital, *d* the recipient, and *a* the fire-place. In this work filtering is described as a species of distillation. It is evident, therefore, that distillation must have been invented before the time of Geber, who merely mentions the process which was then in use. The marginal figure on the next page displays how slow the progress of improvement is,





as this is the still which was employed at a much later period. Indeed, it has been pretty accurately ascertained that the Alembic, for the purposes of distillation, was invented by the Saracens; and to their efforts, in search of the Elixir vitæ, the world is indebted for the greatest curse, next to war, ever inflicted on the human race—the discovery of ardent spirits. The art of distillation is now almost universally understood. In Nubia, a spirit called Bouza is distilled from barley; in Morocco, Brandy is distilled from fermented raisins, and also from the fig, and called *Mahayah*; it is also made in Persia: in Tartary, a spirit called Araka and Arika is distilled from fermented mare's milk, or Koumiss: in the Mysore, it is procured from *jaggory*, a coarse sugar made from the juice of the palm and fermented. The still that is employed is extremely simple. The Burmese and Siamese distil spirits from palm wine, as well as from rice and other grain, and call it *Lau*. The inhabitants of Java, Sumatra, China, and the peninsula of India, all distil *Arrack*; and one of the gifts bestowed by Europeans upon the natives of the Sandwich Islands, and many of those of the Pacific oceans, is the art of making Rum, which the natives call *y-wer'a*, literally *hot water*. It would be impossible to proceed thus with the statement of the nature of the distilled spirits made in the more civilized countries of the world. I will, therefore, confine myself to a few remarks on the nature of the four liquors most generally drunk in Europe—*Brandy*, *Geneva* or *Hollands*, *Whiskey*, and *Rum*.

Brandy is made chiefly from wine. It is a mixture of various proportions of alcohol and water, flavoured by a volatile oil contained in the skin of the grape, which is taken up, in a small degree, during the process of the fermentation of the wine, and which rises with the alcohol in the distillation. Brandy is not naturally coloured; but receives its brownish orange hue from burnt sugar, or Caromel, which imparts to the spirit both odour and taste. Dr. Paris supposes that the peculiar flavour of Cogniac depends on the presence of an

etherial spirit formed by the action of the tartaric or acetic acid of the wine. He also supposes that newly distilled Brandy contains a quantity of uncombined acid, which disappears by age. This modification of diluted Alcohol, in moderate doses further diluted with water, is *cordial* and *stomachic*.

Geneva, or *Hollands*, is distilled from fermented, malted barley. Rye, coarsely ground, is added to this malt; and, both being mixed with a sufficiency of water, the fermentation is promoted, until the liquor has become transparent, and hot and acrid to the taste; when it is put into the still, and the distillation conducted slowly at first, to prevent the essential oil of the rye from rising with the spirit. This crude spirit is then redistilled, or rectified, over juniper berries; and it is from the French term for the Juniper, *Genevre*, that the English name *Geneva* is derived. The discovery of this spirit is attributed to Sylvius, a Professor of Leyden, who lived in the middle of the seventeenth century. It was at first sold as a diuretic in the apothecaries' shops; but, as the common people drunk it with avidity, it soon became an article of trade. When properly prepared, it is a pure diluted alcohol, flavoured with the essential oil of the juniper. Scotch and Irish Whiskey are modifications of the same spirit, devoid of the juniper oil; and the English Gin is also the same kind of spirit, but of an inferior quality, rectified with oil of turpentine.

The early communication of the Phœnicians with Ireland might very probably introduce the knowledge of distillation into that country; and it is undoubted that it was known, and Usquebagh drank there, long before *Aqua Vitæ* was even used as a medicinal cordial in England. The origin of the name Whiskey, which is a mere corruption of *Usque*, shews at once the source whence the Scots obtained their knowledge of Ardent Spirits. The Irish *Usquebagh*, as well as the English *Aqua Vitæ*, were compound spirits; and, according to the Red Book of Ossory, in which there are receipts for making them, they contained saffron and some spices. They were supposed to operate in preserving health, dissipating humours, strengthening the heart, curing colic, dropsy, palsy, quartan fever, stone, and prolonging life; and were, there-

fore, eagerly sought after : but, although this spirit was then emphatically termed *Aqua Vitæ*, its evil tendency in an overdose was also known ; for one of its Irish appellations was *builceann*, head-maddener, a name to which it has not forfeited its title by leaving out the saffron and spices.

The best specimens of Scotch and Irish Whiskey are little more than pure diluted alcohol. They operate as a simple Excitant when taken into the stomach, and, when properly diluted, increase the secretion of the kidneys, and are, consequently, received into the circulation.

Rum is prepared chiefly from fermented uncrystallizable sugar or molasses, and the scummings of the boilers used in the manufacture of sugar in the West Indies and Demerary. The chief peculiarity in this spirit is the large proportion of essential oil which it contains, derived from the raw juice of the sugar cane, and the fragments of the cane, which are mashed up and fermented with the other materials ; for sugar, when employed alone, does not produce a spirit flavoured like Rum. This oil is extremely stimulant, and acts on the cutaneous vessels, causing diaphoresis. Age renders it mild, and bestows softness and a rich flavour on old Rum*. This oil appears, also, to have a very powerful and deleterious effect on the nervous system, before age amalgamates it fully with the alcohol ; as the property of intoxicating, possessed by new Rum, is in a ratio which cannot be accounted for by any circumstance connected with the alcohol it contains.

Such are these four spirits ; all the others, whatever their denomination, may be regarded as merely modifications of these four.

Wine, the next combination of alcohol with other vegetable principles, is necessarily of much older origin than Spirits ; as it must be produced before spirits can be formed. The very first mention of Wine on record, shews us that the grape was the substance from which it was originally produced. We are told, that soon after the universal deluge, Noah began to be a husbandman, and planted a vineyard ;

* The name Rum is supposed to have been derived from the abbreviation of the Latin word, *Saccharum* ; but this is not very probable, as the liquor has always been known among the native Americans by the name of *Rum*.

and he drank of the wine and was drunken*: and, to the present time, the best wine is that of the grape. But Cider, Beer, and Mead are as much wines as that which is made from the grape. The descendants of Noah do not appear to have neglected any means of improving the beverage of their great progenitor; and we find that Palestine was early celebrated for two Wines, those of Eldon and Lebanon; both of which were exported: the former is said to have been a fat and generous wine, whilst that of Lebanon was sweet and powerfully odorous†. Wine from the Palm, and from Apples and Honey, was also made by the Hebrews. The Egyptians made a fermented liquor or wine from Barley; and may, therefore, be regarded as the inventors of Beer: and this appears also to have been the intoxicating beverage of the Armenians; for Xenophon, in his history of the retreat of the Ten Thousand, relates that the inhabitants of that part of Armenia next to Curdistan prepared a potent liquor from a mixture of barley and water. Among the Greeks, wine from the grape was chiefly used; that of Chio surpassing, at that period, all the others in the world. Most of the Greek wines, however, were made from dried grapes and boiled must, which gave them a sweet and luscious character. They kept their wine in bags, made of the skin of the goat stripped from the animal without being cut; the places for the legs being tied up and firmly closed with a compound of resin and wax, which gave their wines a flavour of resin or turpentine; and such is the force of habit, that this flavour is now imitated by adding resinous substances to the wine, as it is no longer kept in bags.

The Pramnian wine of the Greeks, a rough, austere wine, not unlike modern Port, was a medicinal wine: it was that prepared by Hecamede for Machaon, when he received the wound in his shoulder; and was, therefore, sometimes named *Pharmacites*. Neither this nor the Corinthian wine was

* Genesis, chap. ix, verse 21.

† It is supposed that it was this wine which was generally given to criminals immediately before execution; a custom similar to that which formerly prevailed in England, of giving a large cup of ale to malefactors on their way to the gallows.

drunk for pleasure ; and it was only the sweet wines that the Greeks regarded as gratifying beverages.

Hic innocentis pocula Lisbii
Duces sub umbra.

The Greeks also appear to have known the art of making wine from barley ; a discovery with which they were favoured, according to the fertile imagination of Ovid, by the Goddess Ceres, who, nevertheless, was not the inventor. This Wine of Barley, the Oinos Krithinos of the Greek, is, in modern language, Beer. Beer was also early brewed by the Syrians from the grain of the country, and called Zythum. The Bouza of the Nubians, which I have already mentioned as being distilled, is a liquor somewhat like Beer, made from *dhourra*, or barley : and a similar liquor is prepared at Sennaar from roasted barley.

Some of the inhabitants of Ethiopia make Beer : but the chief beverage of Africa is Mead ; a vinous liquor, made by fermenting honey with water, mixed with a small portion of barley. According to the account of Mungo Park and other African travellers, even the rudest nations of the Negro race manufacture Beer and Mead : and the Caffrees make an intoxicating beverage from Millet, which they name Pombie. In Persia, although the Mahomaden faith forbids the use of Wine, and Sherbet is the general beverage, yet several kinds of wine are made ; the best of which is that of Shiraz, which is indulged in privately by the faithful. It is so strong that it will keep for eighty or one hundred years without losing either colour or flavour*. The best Shiraz wine, made from picked grapes, is of a topaz colour, with a fine aroma, and a rough peculiar taste ; but when drunk freely it causes headache ; a constant result of the free use of any alcoholic liquor containing much volatile oil.

The inhabitants of Hindostan do not make beer, nor wine from the grape, but they ferment the juice of the *Borassus flabelliformis*, or 'Tari palm, into a vinous liquor, which the

* On this account it is prized by the Mahomedans, who, in the committal of the sin, think the secret draught should be as potent as possible.

English have named Toddy : it becomes sour in three or four days, and then is only fit to be distilled for Arrack. The natives of Cachmere make a wine from grapes, resembling Madeira : and the Burmese and Siamese intoxicate themselves by sucking *soura*, the fermented juice of the Cocoa nut, through a reed—a fact which seems to prove that intoxication arises more from the impression made on the extreme nerves of sensation than from the absorption of the alcohol. In this mode of drinking, the liquid passes slowly over the papillæ of the tongue, and gives a more decided impression to the nerves.

Little authentic is known of the history of China, in a period which reaches, according to the traditions of that extraordinary country, to many centuries before the period of the world recorded in the Mosaic writings : but from what is known of the early Chinese dynasties, it is probable that wine made from grapes was known in China from time immemorial : but, in the year 1373, most of the vines were ordered to be rooted up by the Emperor 'Tay-tsu ; so that in some of the provinces the remembrance of the vine is entirely forgotten. It was beginning to be cultivated again when Lord Macartney visited the country. Rice wine and palm wine are used in China ; the former is so strong that it may be kept for any length of time. The Chinese make beer, called *tar-asun*, from barley and wheat ; it is rendered fit for keeping, by the addition of hops ; and it is not unlikely that the custom of hopping beer, which was not known in this country until the time of Henry VIII, the period of the Reformation, came originally from China, although we received it from Germany.

Hops, heresy, pickerel, and beer,
Came into England all in one year,

says the doggrel rhyme which records this change in the state of our national beverage. Many of the nations bordering upon China also make Rice wine, and drink it to excess. The Japanese made a very strong and palatable beer from Rice, which they call *Sacki*. It is drank immoderately by all, from the Emperor to the lowest subject ; and often,

when taken cold, produces colic, which is cured by *acupuncture* through the parieties of the abdomen. In the Celebez islands, a Palm wine, called *Sagwire*, is drank for the purposes of inebriation. In the Manillas, Palm and Rice wines are used ; and even the natives of the Friendly Islands, when Captain Cook first visited them, manufactured an intoxicating beverage from the root of the Kava plant, which they chew and mix with water. It is extremely intoxicating, and so destructive to health, that on the second visit of Captain Cook, he saw many of the natives reduced to mere living skeletons from its use. We are told, however, that it is a remedy for syphilis ; a disease which the intercourse with Europeans has entailed on these Islanders. When first taken as a remedy, a scaly eruption breaks out over the skin ; by degrees the scales fall off in the order of their formation, leaving the cuticle smooth and clear, and the system free from disease : at least, such is the account given by a gentleman who visited these islands some years since*.

The only human beings who do not manufacture an intoxicating liquor are the New Zealanders and the wretched natives of New South Wales and Van Dieman's Land.

If we pass from Asia to America, we find that the Mexicans and Peruvians, prior to the Spanish conquest, made beer from Maize, called *Chica* and *Masato* ; and wine from the juice of the Agave. In the present day, grape wine is made in abundance in South America. Cider is also made in Mexico and Brazil ; and the Negroes manufacture a liquor called *Grassa*, from black sugar and water, with the addition of the leaves of the Akaja tree, to render it intoxicating. A wine is also prepared from the roots of the *Jatropha Manihot*. In the United States, the beer, cider, mead, and wines of the old Continent, are freely used.

If we return to Europe, we find that the Romans were immoderately addicted to the use of wine ; but so selfish as to forbid it to their women, who were permitted to be saluted by their relations when they came into their houses, in order

* Literary Gazette, 1821.

to ascertain from the breath whether they had tasted *Temetum*, the term then given to wine*.

The Roman wines were of various character: the *Pucine* wine, which was made in the consulate of Opimius, was good in Pliny's time, after being kept for two hundred years. The wine of *Cæcubum* was noted for its medicinal virtues:

Capaciores affer huc, puer, scyphos,
Et Chia vina aut Lesbia;
Vel, quod fluentum nauseam coërceat,
Metire nobis Cæcubum.

The *Surrentine* and the *Massic* were also recommended by the physician. The *Faustian* was of so spirituous a nature that it would burn with a pure and bright flame. The *Falernian*, so celebrated by Horace, is known by reputation to every one who has had the happiness of a liberal education: it was strong and rough, and could not be drunk until it was ten years old: even then it was necessary to dilute it with a weaker wine. It was also medicinally used; but, according to the advice of Galen, not before it was twenty years old; after which time it became bitter and nauseous. Dr. Henderson† is of opinion that it resembled our sherry. Next to the Falernian, was the *Rhetian*, celebrated by Virgil; and that made upon the Pyrenean hills.

The Phocians cultivated the vine, and made wine in Gaul, 600 years before Christ; but beer was more commonly drunk by the ancient people of France than wine. They were so fond, however, of wine, that Strabo says a whole vintage has been exhausted at one feast among the Lusitanians; and Charles the Great was forced to publish an edict, obliging the judges on the bench and the pleaders at the bar to continue sober. The feasts of the Gauls, in consequence of this love of wine, ended generally in conflicts, and frequently in bloodshed.

* Towards the declension of the Commonwealth, wine was drunk by the Roman ladies to excess. The quantity taken by the men was quite incredible; Novellus Torquatus, who received from Tiberius Claudius the title of Tricongius, or the three-gallon knight, could drink three gallons of wine at a draught; and it is stated that the Emperor Maximin could drink six gallons of wine without feeling its effects.

† History of Ancient and Modern Wines, p. 91.

Beer was generally drunk in France in the thirteenth century : but, at the present time, its use is comparatively trifling ; wine being in many places, and cider in others, the general beverage of the country. In Switzerland, although Kirschwasser, a spirit made from the Machaleb cherry, is much drunk, yet wine is also pretty generally used. In Holland, much geneva and water is drunk ; but ale and beer, which were early manufactured in the Netherlands, and a malt liquor resembling London porter, are much in request. It is scarcely necessary to mention the wines of the Rhine, in referring to Germany. They are the most wholesome in the world ; the least likely to generate acid in the stomach ; and, certainly, the best adapted for the dyspeptic and the gouty. In Hungary, the best wine is the Tokay. The grapes are left on the vine until they are dry and sweet, then collected one by one ; and from them the best *Tokay Ausbruch* is prepared. They are pressed in vessels, the bottoms of which are perforated, so that, before pressure, a portion of the juice runs from them without pressure : this is called Tokay essence, and is very highly prized. The ordinary wine undergoes no other preparation than pressure, and the addition of a little good old wine, when it is strained, after having stood for twenty-four hours ; and then it is fit for use.

It is unnecessary to refer to the other European governments, as nearly the same kinds of beverage are drunk in all ; the farther north we proceed, the consumption of ardent spirits increases, and that of wine diminishes ; except in Russia, where *Quass*, an acid liquor, made from fermented rye ; mead, and some wines made of fruit of different kinds, are the prevailing drinks of the country. It may be here remarked, that more instances of longevity occur in Russia than any where else in the world.

In Great Britain, particularly in England, the vine was very early introduced, having been brought by the Romans ; and, in former days, much wine was made. Ethelwold allowed his monks two obbœ, or big-bellied jugs of wine twice a-day ; and, on festivals, a measure of wine was allowed. The favourite drinks, however, of our Saxon ancestors were

ale and mead. *Pigment*, a sweet and odoriferous beverage, made of honey, wine, and spices, *Morat*, also made of honey, diluted with mulberry juice, and *Cider*, were nearly as much used. The use of wine increased after the Norman Conqueror ascended the English throne ; and we are told that the wine grown in the county of Gloucester was scarcely inferior to that of France. From some causes, which are not well explained, the cultivation of the vine in England declined in the thirteenth century ; and, in the time of Henry III, Ale became again the general drink of the country. In the reign of Henry VI, ale-houses were first licensed ; and the beer sold in them was so generally drunk, that the average quantity then brewed in England was 4,920,413 barrels of strong beer, and 2,254,006 barrels of small beer : a great quantity, but not double the amount of that now brewed in the metropolis alone. Before 1504, the beer drunk in Great Britain contained no hops. The brewing of Porter did not commence until the year 1722 : it was invented by one Harwood, to save the trouble of making a mixture of beer, ale, and twopenny, a drink then in great request ; and, from this new beer being much relished by Porters, it received the name it now bears.

But, although wine was not made to any extent in England, after the thirteenth century, yet foreign wines were much drunk ; and the strongest were in the highest request*. Wine and beer were used at breakfast in the time of Henry VIII, a quart of each being the usual quantity served to two persons. Since the introduction of tea, the use of these beverages has been discontinued both at breakfast and in the evening : but the consumption of wine is still very considerable, considering the high price at which it is sold ; the quantity of foreign wine annually imported amounting, on an average, to 6,010,971 gallons, and the quantity of home-made wines to about 97,500 gallons.

* Sack, a sweet wine, and Sherry seem to have been the favourites :

“ Give me a cup of Sack,—

An ocean of sweet Sack.”—*Rule a Wife and have a Wife*. Act. V.

“ — Sack says my bush ;

Be merry and drink Sherry ; that’s my poesie.”—*New Inn*. Act II.

From this rapid sketch, it is very obvious that alcohol, in its combined state, is regarded by every description of mankind as one of the essentials of life. Let us take a slight view of its nature, both as a chemical compound and in that combination which is usually called wine, before examining its general effects upon the living system, as a beverage and in a medicinal point of view.

The Vine, *Vitis vinifera*, the type of the natural order *Vitis**, is supposed to have been introduced in Europe from Asia Minor, through the successive stages of Greece and Italy. It was carried to France by a colony of Phœnicians, who founded the city of Marseilles; and into England by the Romans. It thrives only in those parts of Europe the temperature of which is high in summer, although the winters be rigorous; but it is a plant easily naturalized. From some change in the climate of England, the Vine cannot be advantageously cultivated here, otherwise it would be attempted†.

Like all plants that have been cultivated from time immemorial, the Vine varies greatly in the character of the fruit which it yields. Although it is a climbing, slender plant, yet Strabo mentions a Vine, the trunk of which two men, with their arms extended, could not embrace. The extent to which it spreads, is also occasionally astonishing: one branch of the Hampton Court vine is 120 feet long: the whole vine, a few years ago (1829) covered a surface of 120 square yards; and in 1816 the crop weighed one ton. Pliny mentions a Vine which was 600 years old.

Wine is the juice of the fruit of this plant, pressed and fermented: and although every saccharine vegetable product, if fermented, will yield wine, yet none equals the grape. The quality of wine differs greatly. The kind of grape, the nature of the soil, the exposure, elevation, degree of latitude, exercise a decided influence upon the chemical character of the juice of the grape, and consequently on the wine which

* Woodville's Med. Bot. 3d edit. p. 141, pl. 57. London Dispensatory, art. *Vitis*.

† Independent of wine, nearly 8000 tons of raisins, yielding to the revenue £160,000, and undried grapes in sufficient quantity to give a revenue of upwards of £10,000, are annually imported into England.

it forms; the quality and flavour being as various as the countries, exposure, and soil in which the Vine is cultivated. That wine which contains the largest quantity of aroma and of intimately combined alcohol, is regarded as the most generous; but the wines of France and those of the Rhine possess agreeable properties, which cause them to be preferred for the use of the table to those of a stronger quality. The grapes ripened in warm climates, as they are more impregnated with saccharine matter and possess more aroma, if properly managed, always yield the best wine.

The expressed juice of the grape contains a large quantity of very soluble sugar, a small quantity of mucilage, some tannin, bitartrates of potassa and of lime, and sometimes sulphate of lime. After this expressed juice, or *must* as it is termed, has remained at rest for some time, the whole becomes moderately warm, the soft parts undergo decomposition, much carbonic acid gas, in small bubbles, is evolved, an intestine motion is raised, and the soft parts are thrown up to the surface, and form a thick scum which collects on the surface, and is emphatically called the hat. This intestine action is accompanied by a hissing noise, and a farther increase of temperature; the mixture, which was before sweet, soon loses its saccharine properties, in a great degree, and acquires a vinous taste, a deeper colour than before, and an odour of alcohol; the intestine motion gradually diminishes, and then, apparently, ceases altogether; the liquor becomes clear, and, being now wine, it is put into casks. The marc, or insoluble part, is next submitted to pressure; and, as the wine obtained from it has been very imperfectly fermented, when it is added to that in the barrel or the tun, the fermentation is renewed, and is continued for many months in a state of less activity than before; throwing up slowly a scum similar to that already mentioned. This scum at length sinks to the bottom of the vessel, carrying with it a certain quantity of the colouring matter, some bitartrate of potassa and tartrate of lime, and the wine is fit for use. Such is the progress of the fermentation by which wine is produced: how can it be explained on chemical principles?

Besides the principal constituents already noticed, the juice

of the grape also contains an azotized vegetable extractive, which, according to Thenard and some other chemists, acts as a leaven, and is the component which sets on foot the fermentative process. This substance attracts a portion of oxygen from the sugar of the must, and, combining with it, is insoluble and precipitates in the form of lees. The affinities of the constituents of the sugar being thus broken, they enter into new combinations; a portion of the oxygen and carbon unite to form carbonic acid, which flies off in a gaseous state; whilst the remainder uniting with the hydrogen and the rest of the carbon, alcohol is produced.

This operation is very neatly and satisfactorily illustrated by a diagram. Let us suppose that three parts of sugar are required to form one part of alcohol and one part of carbonic acid. Now we know that

Sugar is composed of Hydrogen 1 prop. = 1, + Carbon 1 prop. = 6, + Oxygen 1 prop. = 8: = 15.

Carbonic acid is composed of Carbon 1 prop. = 6, + Oxygen 2 prop. = 16: = 22.

Alcohol is composed of Hydrogen 3 prop. = 3, + Carbon 2 prop. = 12, + Oxygen 1 = 8: = 23.

Thence 3 parts of Sugar = Hydrogen 3 + Carbon 3 + Oxyg. 3.

1 part of Alcohol.....	=	3	2	1.
1 part of Carbonic acid	=	0	1	2.
		<u>3</u>	<u>3</u>	<u>3</u>

Wines differ in colour; the red is coloured by the skins of the grapes employed; for the wine is not coloured if the skins of the grape be not fermented in the must. Wines thus manufactured are not sparkling. To procure sparkling wines, the wine is bottled before the fermentation is completed: but, as this proceeds in the bottle, the carbonic acid, from the resistance which it meets with, is redissolved in the wine, and ready to be extricated the moment the cork is drawn. In some instances, as for example in Champagne, the wine not being naturally sweet enough, some sugar candy is added.

Wine is frequently adulterated. When the adulterations are with inferior wine, they are at least innocent: but this is not always the case; for when wine turns sour, it is sweetened with oxide of lead. This is detected by various re-agents --

Sulphate and Subcarbonate of Soda throw down white precipitates.

Hydro-Sulphuric Acid a black precipitate.

Chromate of Potassa } throw down yellow precipitates.

Hydroiodate of Potassa }

Gallic Acid yellowish white precipitates.

But there may be copper as well as lead; this point is easily determined: copper is detected by affording a brown precipitate with ferro-cyanate of potassa: subcarbonate of potassa throws down carbonate of lead, which is deeply blackened by the solution of sulphuretted hydrogen gas.

Arsenic is sometimes used instead of the oxide of lead; it is easily detected by saturating with nitrate of silver in excess, which throws down any muriate or sulphate; and then, when the solution has become perfectly clear, touching the surface with a glass rod dipped in ammonia. To demonstrate that this precipitate arises from arsenious acid, we have only to add ammonia in excess; when, if it be arsenious acid, the precipitate will be dissolved.

In examining the effects of alcohol as an Excitant on the animal œconomy, I will adopt the same arrangement as in the investigation of its physical and chemical properties; first taking into consideration its effects in its uncombined or pure state, and afterwards, those which it exerts in a state of combination.

If alcohol in its pure state be applied to dead animal matter, it acts as an astringent, lessening the bulk of the substance and condensing it; but this effect is due, in a great degree, to its powerful attraction for water, and the greater density of the compound which follows the abstraction of the water. Owing to this power of increasing the cohesiveness of dead animal matter, and abstracting the water from it, the substance upon which alcohol has acted is undoubtedly less liable to undergo the decomposition that all dead organized matter rapidly runs into; and on this account strong alcohol is said to exert an antiseptic power. The same property of powerfully attracting water gives alcohol the power of coagulating the albumen in animal matter; and, in proportion to the insolubility of animal matters, they become

more permanently capable of resisting the impression of other agents. The consideration of this influence of alcohol on dead animal matter induced some to believe that it acts nearly in the same manner on the living body : but this is not the case ; for, while vitality continues, no power with which I am acquainted can coagulate the fluids.

When diluted uncombined alcohol is applied to the living body, the first effect is excitant ; it acts upon the nervous energy, increasing the tone of the part, diminishing the capacity of the blood vessels, and adding to their power of carrying forward the blood which they contain. This effect is in the direct ratio of the strength of the alcohol, and the susceptibility of the part to which it is applied ; and thence, in parts of the body in a state of inflammation, alcohol, applied as a local excitant, relieves the state of congestion, or overdistension of the vessels that characterizes that morbid condition. When applied however to healthy surfaces, particularly to those in which there is much sensibility, the impression of increased energy, and the contraction which suddenly takes place and renders the portion of surface acted upon pale, is of short continuance ; the vital energy is rapidly exhausted, and inflammation is the consequence. This is not the proper place to enter into an enquiry regarding the theory of inflammation ; but it is impossible to see these effects of the application of concentrated alcohol to inflamed and to healthy surfaces, without forming in the mind some explanation of the phenomena passing before us.

The exciting property of concentrated alcohol becomes obvious to our senses, by the effect which it produces on the organs of taste and of smelling. When taken into the stomach, its primary effect is local on the organ itself ; it inflames the mucous membrane and soon destroys its vitality ; the shock is communicated through the nerves to the brain ; and the individual often dies before there is time for absorption to have taken place. The truth of this remark has been demonstrated by the experiments of Mr. Brodie. When he killed animals by injecting alcohol into the stomach, he always found, on dissection, that the organ displayed marks of powerfully inflammatory action, and that blood was extravasated be-

tween the coats ; but, except a gorged state of the vessels, no preternatural appearances were remarked in the brain ; the inference therefore that the fatal shock is altogether on the nervous energy is strengthened by dissection. But this state is only the result of the admission of alcohol, in its highest state of concentration, into an organ of extreme susceptibility, although of little sensibility : when it is partially diluted, it acts with less energy, and merely produces that state which is termed intoxication. It is not easy to explain, very satisfactorily, the condition of the brain under these circumstances ; whether it can be regarded as one of activity ; or, as in some kinds of delirium, a state of stupor, in which the mind acts as it were independent of the material organ with which it is connected, and ideas succeed one another in certain associations. But here we tread upon the boundaries of metaphysical ground ; and, if we proceed, may entangle ourselves in a labyrinth of difficulties from which we shall never be able to escape. Let us, therefore, confine ourselves to the statement, simply, of the effects which follow the introduction of a large quantity of moderately diluted alcohol into the stomach. Its first effect is the local excitement of the gastric nerves, increasing the sensibility of the organ : this impression is next conveyed to the brain and entire nervous system ; ideas of unusual brilliancy pass through the mind ; there is, as it has been beautifully expressed, a soft tumult of the soul ; Fancy is awakened, and creates, from uninterrupted associations, new combinations and a world of its own : and it is at this happy moment, between sobriety and intoxication, that the poet sometimes pours forth his sublimest conceptions and most harmonious strains. As the power of the stimulus however increases, all controul of the will is suspended ; the ideas are then irregular ; and, instead of being combined in such a manner as to produce even agreeable conceptions, they arise in the mind in the most incongruous order ; the voluntary muscles cease to act, vertigo supervenes, and delirium follows. The exhausting influence of such a state is too great to continue : in a short time collapse, and sleep resembling that of apoplexy, follow. Under certain states of the habit, this sleep may prove the prelude to death ; but, in the majo-

rity of instances, Nature adopts this method of restoring the exhausted excitability; yet the individual does not awake in his usual state; his hand is tremulous; his limbs are weak and unsteady; his surface is susceptible of the slightest impressions; his stomach nauseates all kinds of food; his thoughts are gloomy; his temper irascible; and, if the moral principle be not blunted by the frequent repetition of this vice, his mind is overpowered with the most distressing sense of degradation. By degrees, however, the system recovers its usual condition.

The tumult, which the administration of a large quantity of even diluted alcohol on the living system causes, is very obvious from the observation of this train of symptoms; and, as I shall afterwards prove, depends, in a great degree, on the impression of the Excitant on the nervous energy, altogether independent of absorption. The truth of this position is maintained not only by the fact of intoxication being more rapidly produced by some kinds of ardent spirits than by others, although the same quantity of alcohol be contained in all of them, but also by its being produced more rapidly and by a much smaller quantity of spirits, when taken into the stomach in such a manner that the nerves of the mouth, with those of the tongue and fauces, shall be topically acted upon; and, lastly, by the fact that a person who is intoxicated becomes often suddenly sober after vomiting. The inebriating effect of sucking *Soura* through a reed upon the Burmese and Siamese has been noticed; that it is the effect of alcohol on the extremities of the nerves, is well illustrated by the following anecdote. A merchant, who had collected furs on the Mississippi, when Louisiana was yet almost in a state of nature, carried the cargo to Jamaica to sort the furs before transporting them to Europe. He hired a store in Kingston, in the yard of which were several casks placed on end in the sun, and employed as labourers several soldiers of the garrison to assist in landing his furs, men who had been in the habit of drinking freely of new rum, and were able to sustain, with impunity, very copious libations of ardent spirits; nevertheless these men were drunk every day before noon. On investigating the cause, the merchant discovered that they

had broached one of the casks which contained Madeira, and that they became drunk by sucking the wine through straws.

The stomach may resist the deleterious influence of occasional intoxication; but a regular train of intemperance never fails to produce its baneful influence both on the body and the mind. By degrees the mucous membrane of the stomach, suffering under repeated attacks of inflammation, and even the other coats of that viscus, undergo changes of structure, and indurations supervene, which occasionally degenerate into cancer of the pylorus; or, inflammation of the liver, palsy, dropsy, epilepsy, and many other bodily ailments, overpower the vital energy of the system.

Amongst the diseases which follow a habit of intemperance in the use of ardent spirits is delirium tremens; a disease involving the whole of the nervous system, accompanied with restlessness, inappetency, headache, confusion of ideas, wildness of look, tremors of the extremities, sometimes extending to the trunk, and delirium. These symptoms can be invariably referred to habitual intoxication: for the excitement which alcohol impresses on the stomach is communicated to the nervous centres; the renewed irritations of the brain exhaust its powers; and the organ of intellect being no longer in a healthy state, the mind itself suffers; the memory and the judgment become enfeebled; and, as during every debauch there is a temporary aberration of intellect, the frequency of these, when a disposition to insanity exists, at length shakes Reason from her seat for ever. It may be said that some men have lived to a good old age who have been habitual drunkards: this is true, but it is an exception to a rule*.

But if the dietetical abuse of alcohol produce such melancholy results, the medicinal employment, and the temperate indulgence of it, under certain circumstances, are of great benefit to the human race. Temperately taken, diluted

* This resisting power of some constitutions is well illustrated by the Poet of the Seasons:

“ Perhaps some doctor, of tremendous paunch,
Awful and deep, a black abyss of drink,
Outlives them all; and from his buried flock
Retiring, full of rumination sad,
Laments the weakness of this latter time.”

alcohol operates as a wholesome stimulant; rousing the action of the heart and arteries, diffusing an agreeable increase of temperature over the body, assisting the powers of the stomach, promoting the various secretions, and exalting the nervous energy. It may be reasonably asked, however, of what benefit is even the temperate use of ardent spirits to a healthful individual, who requires no additional excitement either of his mental or corporeal energies? To this question no satisfactory reply can be offered: and, notwithstanding the universal propensity of the human species for intoxication, and the ingenuity exercised in obtaining means to effect it, yet ardent spirits can be justly regarded in no other points of view than as a medicine or a poison.

As a medicinal agent, alcohol is a most powerful and universal Excitant. Although its action is followed by sedative and narcotic effects, yet its exciting influence is too great to permit us to employ it as a narcotic. Diluted alcohol can be used only in those fevers, and in those periods of fever, which indicate much depression of the powers of life: even in the lowest fevers, the dilution must be very considerable: one part of ardent spirits to four or five parts of water, sweetened with sugar and acidulated with lemon-juice, form an excellent substitute for wine; nevertheless, it is more heating and less tonic than the fermented juice of the grape.

Alcohol, however, although so powerfully exciting, yet, when properly diluted, it may be employed, under certain circumstances, in the phlegmasiæ, if no vital organ be affected; as occurs, for example, in phrenitis, pneumonia, gastritis, and hepatitis. In passive hæmorrhages, the use of diluted alcohol has been sometimes advised: if it can prove in any way useful in these cases, we must look for the cause of the benefit in the exciting property of the alcohol, which enables it to apply those curative powers that, without adopting the wild doctrines of a "*vis medicatrix naturæ*," tend to restore every diseased state of the functions to the natural condition, or that of health.

In all chronic diseases, which are generally those of debility, alcohol, properly diluted, may be administered. It is very commonly employed, in dyspepsia, for removing the sup-

posed debility of the stomach; and for this purpose is given in conjunction with bitters, aromatics, and tonics in the form of tinctures: but much caution and great judgment are required for prescribing it in these cases. In dyspepsia, too little attention is given to ascertain the real state of the stomach and other digestive organs: debility is often inferred when the symptoms proceed from subacute inflammation; in which state there can be one opinion only with respect to the impropriety of prescribing Excitants under any form. When dyspepsia is accompanied with vomitings, colic, or hiccough, depending on some morbid action of the brain and the spinal marrow, then the powerfully inciting influence on the stomach may prove beneficial, by inducing, as it were, a revulsion, and breaking, in a short time, the morbid train of diseased action present in the stomach, the intestines, or the diaphragm.

As an external application, alcohol is an admirable Excitant; gently constringing the vessels and communicating a new stimulus to inflamed surfaces. Thus, it forms an excellent lotion, when moderately diluted, in erysipelas, in erythema, in burns and in scalds while the cuticle is yet entire, and in sprains and recent bruises. In these cases, it allays pain, affords a sensation of cooling to the inflamed surface, and stimulates gently the overloaded vessels to carry forward the blood with which they are oppressed.

It is impossible to foresee what may be the result of a state of severe intoxication. Mr. Bedingfield, however, has directed attention to one symptom which is likely to aid our prognosis. "If the iris," says he, "retain its contractile power, the patient will generally recover, however overpowered the senses may be; if, on the contrary, it remain in a state of extreme dilatation when a strong light is directed upon it, but a feeble hope of recovery must be entertained.*" When it can be effected, the first object, in a case of intoxication, as in every case of poisoning, is to dislodge the offending matter as quickly as possible; and there is no reason why the stomach-pump should not be employed in these cases as in other instances of poisoning. Our second object is to obviate

* Bedingfield on Medical Practice.

the impression made on the nervous system; and, to effect this, nothing answers better than the acetate of ammonia, in doses of ʒii or ʒiv, in a glassful of water, frequently repeated. This seems to exert almost a specific effect upon the habit, and prevents those uncomfortable feelings which invariably accompany the transition from drunkenness to sobriety.

If alcohol in its pure state, or simply diluted with water, produce these effects, we must also look for them from combined alcohol under whatever form it may be taken. It is not my intention, therefore, to go over the same ground as far as refers to *ardent spirits, wine, cider, beer, and mead*; but, under the head of wine, to offer a few useful remarks on the dietetical and therapeutical employment of diluted alcohol comprehended in all these forms.

Wine not being a simple substance, but containing alcohol, acids, bitartrate of potassa, tannin, and colouring matter, it cannot when taken into the stomach be regarded in the same point of view as simple alcohol diluted with a large proportion of water; something must therefore be referred to the chemical properties as well as to the stimulant operation of these substances. If the wine contain much acid, and particularly if this be malic acid, the tendency to decomposition, when in a temperature equal to that of the human stomach, and also to increase the tendency to acescency in the other contents of the stomach, when the vital action is languid, are well known; and consequently a conclusion might be drawn, that wine, instead of promoting, rather tends to disturb the powers of digestion in languid habits and in the dyspeptic. It is a curious fact, also, that these disadvantages are augmented when the wine contains uncombined brandy, which might, *a priori*, be supposed to act in the same manner as diluted alcohol, but which is not the case. Some explanation of this may be obtained from the fact, that the addition of a certain portion of free alcohol, instead of checking fermentation, favours it. When this simple admixture of alcohol does not exist in wine, but when the alcohol is intimately combined with the other ingredients, and the acid is the tartaric, at least when the malic and acetic do not abound, then, instead of interrupting digestion, the moderate use of wine

tends to promote it by stimulating moderately the nerves and muscular coat of the stomach, thus promoting the proper secretion of gastric juice as far as regards both its quantity and quality. This wholesome stimulus will, nevertheless, vary in proportion to the nature of the aromatic principles contained in the wine, even when the alcohol is, as it were, disarmed of any deleterious properties by its intimate combination. The nature of this combination into which the alcohol enters influences also the effect of wine in causing intoxication; for, if we take the same quantity of brandy or alcohol contained in a given quantity of wine, and merely mix it with water, it will sooner and more effectually produce intoxication than when it is taken in the shape of wine. This, however, does not arise from the mere presence of the other ingredients; for alcohol, mixed with these in the same proportions as they are found in wine, is equally deleterious and inebriating. It is, therefore, evident that the dietetical properties of wine depend greatly on the nature and quality of the wine which is employed.

Something is due, in reference to its effects, to the time at which wine is usually drunk. Custom has consecrated to this purpose the time immediately after our principal meal in this country; but, if we reflect that the stomach is then loaded with food, that the process of chymification is a natural one, and is likely to be rendered imperfect, either by any thing which can interrupt the series of changes which it is intended to produce, or by altering the affinities of the components, or by overstimulating and consequently hurrying the secretion of the chief agent concerned in promoting these changes, the gastric fluid, we can scarcely imagine a worse-selected time for drinking wine than after dinner or after supper. It is true that this custom has been followed from time immemorial; and neither the moralist nor the physician is likely to have influence sufficient to alter it: but, if the physician cannot interfere with the habits of the healthy, he can at least warn the invalid of his danger, and point out to him the proper time of taking wine when this is necessary for promoting the powers of digestion. Now, if our object be to excite the stomach, so as to enable it to secrete a better description of

gastric juice, it is certainly more rational to effect this before the stomach is called on for the performance of its digestive functions than at the moment when these functions are operating in the actual execution of the purpose for which the improved secretion is intended. In a dietetical point of view, therefore, wine should be taken before dinner, or at some period of the day when chymification is not in progress. If this opinion be correct as far as regards the healthy, it is much more so as far as the dyspeptic are concerned. The number of cases of dyspepsia depending on mere want of tone in the stomach are few ; and it is in such cases only that wine or alcohol, in any form, can be properly prescribed. In dyspepsia, in general, there is a morbid determination of blood to the mucous coat of the stomach and the intestinal canal : this is marked by the symptoms which characterize the disease—heartburn, irregularity of appetite, nausea, depression of spirits, dreaming, weight and pain in the head, vertigo, and uneasiness, if not pain, in the stomach itself ; and, under these states, the effect of the administration of wine is likely to be subacute inflammation of the stomach and intestines ; if gout, erysipelas, anasarca, or some other disease, do not supervene as a salutary process to relieve the digestive organs.

These brief remarks are sufficient to determine the value of wine in a dietetical point of view ; but, as I have already said, custom is too powerful an opponent of the doctor ; and, therefore, the physician can do little more than direct the choice of that wine which is least likely to interfere with the healthy functions of the system. There are four distinct descriptions of wines employed in this country : *sweet* and consequently only half-fermented wine ; *brisk* and *sparkling* wines, in which the fermentation has been suppressed, and one of its products again redissolved in the wine ; *light* and *subacid* wines ; and *dry, strong* wines, which contain a considerable proportion of uncombined alcohol.

The *sweet* wines in occasional use in England are *Mountain*, *Malmsey-Madeira*, *Constantia*, *Tent*, *Lisbon*, *Frontignac*, *Tokay*, and some others. All these wines are exceedingly apt to disorder the stomach, owing to their imperfect fermen-

tation. They do not intoxicate so freely as some other wines; and, as the ancients used them in preference to the other wines, and diluted them largely with hot water, it is probable that their powers of drinking large quantities of wine without suffering from intoxication depended, in a great degree, on this choice of their wine. But, as these wines promote acidity, they should never be drunk but in their most perfect state and in very limited quantity.

The *brisk* and *sparkling* wines are the produce of Champagne chiefly; but, of late years, a brisk wine has also been manufactured in Burgundy. These wines seem to affect the nervous system very rapidly, and intoxicate sooner than dry wines which contain a much larger proportion of alcohol. This may depend on the carbonic acid combining intimately with the alcohol they contain, and consequently enabling it to be applied to the extremities of the nerves of the stomach, in a form peculiarly well calculated to make a powerful impression upon them. But, if these wines intoxicate more rapidly than other wines, their effect is more transitory; and the recovery from inebriation from their use is much less severe, and the subsequent exhaustion less, than from other wines; thence a fair inference may be drawn, that, in this respect, they are undoubtedly more wholesome. In some hypochondriacal diseases, and what are termed nervous affections, they may be drunk in moderation; and few opinions are more fallacious than that which regards them as injurious to gouty habits. Something, however, must be attributed to the nature of the wines, in deciding on their wholesomeness. When they effervesce greatly, it is a proof that they are either too new, or that they contain substances introduced expressly to promote their briskness. Indeed, the still wines of Champagne, or those that effervesce only moderately, are always to be preferred.

The *light* although frequently subacid wines of the Rhine and of the Bordelais are certainly much less likely to influence, injuriously, the nervous system than any others. They are less intoxicating and generally possess diuretic properties. Those of the Rhine also, although acidulous to the taste, are less likely to ferment on the stomach than stronger wines;

both because the acid which they contain is the tartaric, and also because their alcohol is more intimately combined with the other principles of the wine. Those of the Bordelais possess less aroma and spirit than even the Rhine wines: but either are certainly the safest for daily use.

The *strong* wines, such as *Port*, *Sherry*, *Madeira*, and the spirituous and highly aromatic wines of Burgundy, are the least wholesome, although the most generally drunk in Great Britain. Much of the potency of port and sherry arises from uncombined brandy, which is mixed with them previously to their exportation. The large quantity of tannin and gallic acid which they contain render them hurtful as a daily beverage: they, also, intoxicate much sooner than the light wines; and, from the nature and quantity of their volatile oil, they affect the brain in the same manner as narcotics; not exhilarating and enlivening the fancy, except in the very outset of their influence, but producing a sluggish state of the system and an evident tendency to apoplexy. The wines of Burgundy and some of the lighter wines of Spain and Portugal are free from these injurious properties; but they are, nevertheless, more pernicious in their effects than the wines of France and the Rhine.

These observations apply equally to ale, porter, cider, and mead. In the ale and porter, the saccharine matter mixed with the bitter of the hops furnishes vigor to the system, from the digestion of these ingredients: but their daily use disposes to plethora and produces an evident tendency to apoplexy. Cider and mead act on the stomach like the lighter wines.

With regard to the therapeutical use of wine, enough has already been said respecting its use in dyspepsia: I will, therefore, confine my remarks to its employment as a remedy in continued fever.

In continued fevers, wine is often the only remedy upon which we can with confidence rely; but where there is much irritability present, all violent diffusible and transient Excitants are hurtful, as their first effects are rapidly followed by a correspondent debility; and much injury was formerly done by the inconsiderate use of such agents. Wine, however, under proper management, is well adapted for the advanced

stages of continued fever. Its exciting powers are of primary importance, and it is agreeable to the palates of most patients. Various circumstances however are necessary to be attended to in its administration.

1. The habits of the patient must be known. If, during health, he has been in the daily use of wine, it will be more necessary, proper, and safe, than if his habits were abstemious.

2. Its use in continued fever is indicated by the advanced stage of the disease, by a frequent, small, and compressible pulse, symptomatic of great debility; by low muttering delirium, and by that twitching of the limbs which is known by the term *subsultus tendinum*.

3. The appetite, and desire for it, must also be attended to. In continued fever, reason is often suspended, and instinct seems again to resume its sway; if the patient has, therefore, a strong instinctive desire for wine, it seldom happens that the indulgence of this is improper. Sir John Pringle pointed out strongly the necessity of attending to this desire: "when the low state of the fever," says he, "was present, the sick had frequent cravings for cordials and wine; they drank the wine greedily; but, when they were in a state in which the use of cordials was questionable, they were careless about the wine."

4. The effect of the wine must be watched. If it do not disorder the functions of the stomach, nor increase the heat of the surface, but fill the pulse and lessen its frequency, mitigate delirium, and remove restlessness, then we may conclude that it is not only proper, but absolutely requisite.

5. When the disease arises from contagion, when the pulse is languid, when the spirits are oppressed, and there is no phlogistic diathesis, wine may be given in any stage, even the earliest, of continued fever. The quantity to be given must be determined by the judgment of the practitioner. A bottle of Rhenish or Claret may sometimes be taken even by females unaccustomed to wine; but two bottles of the strongest wines have been administered with advantage. The powers of the healthy body to bear wine are no criterion of what may be borne in typhus fever. It should be given in small quantities and frequently repeated; and when advantage is obtained from its employment, it must not be rapidly withdrawn, but

gradually diminished as the febrile symptoms abate and the system becomes more susceptible of its impression.

6. With regard to the kinds of wine, Claret and the Rhenish are more proper than the stronger wines in the earlier stages of fever; and the stronger, such as Port and Sherry, in the later or sinking stages. The lighter wines tend rather to open than to confine the bowels; the stronger, to check diarrhœa.

7. The form of administering the wine will greatly depend on the state of the stomach, and on the taste and inclination of the patient. If a dislike be taken to the wine, it should be warmed, sweetened with sugar, and slightly acidulated; and the lips of the patient moistened with it: by this plan he rarely fails, in a short time, to relish it, and to take the quantity that is necessary. In general, it is prudent to dilute wine, especially in the earlier stages of fever; and to many febrile patients it is most grateful when diluted with cold water. It is also very much so when given in the forms of negus and of whey. In cases of obstinate intermittent fever, which have worn down the strength of the patient, wine is useful, as it tends to re-establish the healthy action of the nutritive functions and to improve the vigour of all the organic tissues. Wine proves hurtful in neuralgic and rheumatic affections.

Upon the whole, we may say of wine, as of every thing else, it is either a blessing or a curse, a medicine or a poison, according to the discretion and moderation with which it is used, and the skill and judgment which direct its medicinal employment.

g. SULPHURIC ETHER.

L. E. D.

Sulphuric Ether is prepared by distilling equal parts, by weight, of Sulphuric Acid and Alcohol in a sand bath previously heated to 200°, and carrying on the distillation until a white fume begins to appear in the retort; at which time Sulphurous Acid is disengaged and oil of wine generated. On adding more alcohol to what remains in the retort, and continuing the distillation, an additional quantity of Ether is obtained. Such is the general outline of the process for procuring Sulphuric Ether; but as, in this state, the product,

besides pure Ether, contains also some alcohol, water, and Sulphurous Acid, potassa fusa or dried chloride of lime is added, which unites with the water and Sulphurous Acid; and, by a second distillation, pure Ether, the *Æther rectificatus* of the Pharmacopœias, is procured. Pure Sulphuric Ether is perhaps the most volatile and inflammable substance in nature. Under the common temperature of the atmosphere it is converted into vapour, and in assuming this form produces great cold. Its specific gravity, as it is usually procured, is 0.730: but in its purest state it does not exceed 0.632. It is colourless, has an agreeable odour, and a hot, pungent taste. Ether of the specific gravity of 0.730 boils at 98° , under the usual pressure of the atmosphere: but when this is taken off, as in the vacuum of an air pump, it boils at a temperature under the freezing point; and the vapour into which it is converted has a specific gravity more than double that of atmospherical air, being to air as 2.586 to 1.000. If this vapour be approached by any incandescent body, it inflames: and, when united with oxygen, explodes violently, forming water and carbonic acid. If Ether be exposed to light in a vessel partially filled, it absorbs oxygen, and acetic acid is formed. Water takes up one fourteenth only of its weight of pure Ether, even when it has been agitated with it: but Ether unites with alcohol in all proportions. It has no action on the earths which are medicinally employed, nor on the fixed alkalies; but it combines in all proportions with pure ammonia. It dissolves corrosive sublimate, which enables us to employ it as an agent for detecting the presence of small quantities of this salt in aqueous solutions. The Ether is agitated with the fluid suspected to contain the sublimate, and then left at rest: by decanting off the Ether and evaporating, if any sublimate be present, it will be left in the form of a white powder. Ether dissolves the fixed and the volatile oils, resins, bitumens, the white of egg, and the active principles of many plants*.

In order to understand the rationale of the production of

* One useful quality is due to Ether from its volatility: if a few drops be put into a damp phial, it quickly evaporates and leaves the phial completely dry.

Ether, we must recollect that alcohol consists of 2 prop. of Carbon, 1 of Oxygen, and 3 of Hydrogen. Now the process of the formation of Ether seems to depend on a change being effected by the acid on the alcohol, and, after that is over, a reciprocal change on the acid. Thus the alcohol is divided into two parts; the first passes into the state of Ether by losing one half of its Oxygen and one sixth of its Hydrogen, and the new combination of its altered proportions of ultimate components produces the Ether. The changes which the acid undergoes are not yet well understood. According to this theory, Ether differs from Alcohol merely in the difference of the proportions of the ultimate constituents. This will be rendered evident by comparing the proportions of the constituents of the alcohol employed with those of the Ether formed.

Alcohol, two atoms.		Ether, one atom.	
Carbon	. . 4 prop. = 24		4 prop. = 24
Hydrogen	. . 6 prop. = 6		5 prop. = 5
Oxygen	. . 2 prop. = 16		1 prop. = 8
	Equiv. = 46		Equiv. = 37
Abstract 1 prop. of Hydrogen = 1			
1 prop. of Oxygen = 8—9			
		Ether = 37 is left.	

According to the theory of M. Dabit*, the surplus Hydrogen and Oxygen lost by the two parts of alcohol may be thus accounted for: the 1 prop. of Hydrogen causes the sulphuric acid to pass into the state of sulphuretted hydrogen; whilst the 1 prop. of Oxygen unites with the second portion of the Alcohol, and constitutes a new vegetable matter; the elements of which, reacting on the sulphuretted hydrogen, decompose it, and form sulphurous acid gas, carbonic acid gas, oil of wine, carbonated hydrogen gas, and the carbon which is deposited and forms the black residue in the retort†. But a simpler mode of comprehending the theory of the

* Ann. de Chimie. t. xxxiv, p. 289; and t. xliii, p. 101.

† The formation of a new acid in the production of Ether was discovered by M. Dabit of Nantes in 1800: he named it Sulpho-vinic Acid. Vogel and Gay-Lussac suppose it to be a compound of hyposulphuric acid and a vegetable matter.

formation of Ether is to consider the composition of Alcohol and of Ether in reference to the proportions of water and of olefiant gas which each contains. Thus, if we admit that Ether consists of two equivalents of olefiant gas and one equivalent of aqueous vapour, and that Alcohol consists of one equivalent of each, we can easily imagine that, by abstracting one equivalent of water from two equivalents of Alcohol, the result will be Ether; and this the action of the sulphuric acid on the Alcohol is well calculated to produce, owing to its powerful affinity for water.

The purity of Ether is best determined by its specific gravity; but it is also determined by other means. Thus, if it reddens litmus, or precipitates the muriate of baryta, it contains sulphuric acid: if it produces a milky solution with phosphorus, it contains Alcohol.

Such is Ether as a chemical compound: as a medicinal agent, it operates as an Excitant on the animal œconomy. When it is taken in large doses, it acts powerfully on the nervous energy, causing vomiting and diarrhœa, increases the force of the heart and arteries, and, in fact, causes a temporary intoxication. Like other diffusible Excitants, its effects are rapidly propagated over the system, and soon dissipated. From its volatile nature, its exciting influence is probably augmented; as it produces distension of the stomach and bowels, and is thus applied to every portion of their sensitive surface. It is also probable that it is absorbed in its state of vapour, and is, consequently, directly applied to the nervous centres.

Ether taken in a large dose causes immediate headache, obscurity of sight, and evident intoxication; accompanied with a sensation of burning heat in the stomach, and tenderness of the epigastrium. These symptoms, however, are transitory, and the effects of the intoxication are much sooner dissipated than those produced by ardent spirits. It is this diffusible nature of the stimulus of Ether which renders it so well adapted for causing sudden excitement, and producing immediate results. Its effects, however, so soon disappear, that the dose requires to be frequently repeated.

Ether has been used in the cure of diseases both externally

applied and when taken into the stomach. Externally applied, its exciting property enables it to act as a counterirritant; thence it relieves toothache when applied to the jaw and retained on it with the hand. In the same manner it eases earache not caused by local diseases of the internal ear, and it is very beneficial in all rheumatic pains.

Internally administered, Ether, in doses of twenty drops or more, in a glass of cold water, stimulates the gastric nerves, checks the vomiting which often occurs in dyspeptic affections, and aids the digestive powers of the stomach. When given in smaller doses, frequently repeated, it produces a decidedly cordial effect. In fevers of a malignant kind, it is useful in allaying twitchings of the tendons, hiccough, and other symptoms dependent on the morbid state of the nervous system. It is beneficially prescribed on the approach of the accession of the paroxysm in intermittents; and it often succeeds in preventing the attack; or, if it do not at first effect so much, the return of the paroxysm is marked by slight fever only, without any rigor; and this gradually disappears by continuing the use of the remedy.

M. Bourdier has employed Ether as a vermifuge; and it is to its exciting powers only that the success which he has obtained can be ascribed. He gives a dram of Ether in a glassful of cold decoction of the male fern: soon afterwards, two drams, in a sufficient quantity of the same decoction, are administered as an enema, so as to fill the whole intestinal canal with vapour of Ether; and, in another hour, two ounces of castor oil are swallowed by the patient. The worms are thus first destroyed, and afterwards expelled.

Ether may be administered either pure, in water, or it may be combined with the volatile oils or with resinous substances. The medium dose of Ether is $\text{f}\text{ʒi}$; and it is seldom given in larger doses, the repetition of the dose being more useful than the magnitude of it.

The only officinal combinations of Ether which operate as simple Excitants are the Spirit of Sulphuric Ether and the Aromatic Spirit of Ether. The former is composed of one part

of Ether combined with two parts of alcohol: it is a limpid, volatile liquid; and, like Ether, it excites the living system, acting powerfully on the nervous system as well as being absorbed. It is extremely useful, in low febrile complaints, in allaying nausea and vomiting and diminishing thirst, which it accomplishes by stimulating the salivary glands. The Aromatic Spirit of Ether, in addition to the Spirit of Sulphuric Ether, contains the volatile oils of cinnamon and of cardamoms, long pepper, and ginger. It is used as an Excitant instead of the pure Ether, and answers every purpose for which that medicine is prescribed.

INORGANIC SUBSTANCES WHICH OPERATE AS EXCITANTS.

The first of the medicinal agents of this division of Excitants is one of great power—Electricity.

ELECTRICITY is a material agent, which, like caloric, is diffused over the whole of nature; the earth and every body with which we are acquainted containing a certain quantity of it. As long as they contain what may be termed their natural share, *Electricity*, like insensible caloric, remains dormant in them, producing no sensible effect; but it can be abstracted from one body and communicated to another in a degree much beyond their natural share. In bodies charged with it, remarkable effects arise; and the bodies are said to be electrified. Those bodies, also, which are thus overloaded, as it were, with the electric fluid, and those, also, that have been exhausted of it to furnish this charge, are both said to be *insulated*, when the condition of the surrounding bodies prevent either from altering their state. In this respect, the laws which regulate the motions of the electric fluid differ from the laws that regulate those of caloric. It has, nevertheless, been supposed that Electricity is a modification of the material agent which produces the phenomena of heat and light: it is unnecessary to enquire into the probability of this hypothesis. Bodies which are charged with electricity, or electrified, being in a state fitted to impart a portion

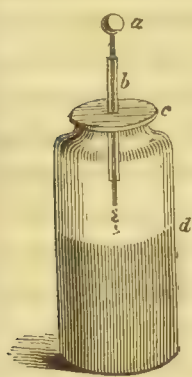
of what they possess to other bodies, attract light bodies, which receive a portion of their load, and are then immediately repelled. Thus, if a glass tube or a stick of sealing wax be excited by rubbing it with fur, or silk, or flannel, a feather will be attracted by it; but, as soon as the feather becomes saturated with the electrical fluid, it will immediately fly from it to discharge its now-redundant electricity on the nearest conductor. Electrified bodies also display the existence of the substance with which they are charged by obvious signs: in discharging their electricity, they make a sensible impression on the organs of touch, those of sight, and also that of smelling.

By this term, *conductor*, is meant bodies over which the electric fluid passes easily, as is the case with all metals, plumbago, charcoal, water, plants, the animal body, and animal fluids; whilst substances through which it does not pass readily, but on which it can be accumulated, such as *glass, sealing wax, sulphur, baked wood, dried animal substances, resins, oil, and air*, are *non-conductors*. The best conductors of electricity are silver and copper, among the metals; the worst is lead*. Moisture is an admirable conductor; thence, in moist weather, electrical experiments rarely succeed, because the moisture prevents the accumulation of the fluid in *non-conductors*, which are rendered *conductors* by its presence. Thus, a green twig is a conductor, a dry or baked twig a non-conductor; moist silk is a conductor, dry silk a non-conductor. Electricity may be accumulated on any body which is surrounded with non-conductors or is isolated; and it is on this account that persons in whom we wish to accumulate electricity are placed upon stools with glass feet, glass being a non-conductor. The person thus electrified is said to be so by communication; and this isolation will be as complete, if, instead of glass, the supporting body be silk, or a cake of sulphur, or resin, or sealing wax, or bees' wax.

Electricity is most readily excited in bodies by friction. When two substances, which are non-conductors, are rubbed together, the electrical matter cannot be diffused; but, if another substance which is a conductor be presented to them,

* Phil. Trans. 1827, part i, p. 21.

the electrical matter is abstracted from them and diffused over this conductor. On these principles the electrical machine is constructed. The electricity evolved by it is derived from the earth; thence the necessity of maintaining a communication between the rubber of the machine and the earth by means of a metallic chain: through this the electricity which is given to the glass by the rubber is supplied from the earth. There are many other modes of exciting electricity; but it is unnecessary to describe them here.

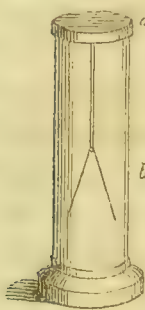


The most common and most useful instrument for accumulating electricity is the Leyden phial or jar*. If the electrical machine be turned, and the knob, *a*, of the jar be held near to the prime conductor, the electrical matter collected from the earth passes into it, and is accumulated on the coated surface of its inside; and, as no communication exists between the inside and the outside of the jar, it will remain there for a

considerable time: but, if I establish a connection between the two coated sides, by means of any conducting substance, the electricity will immediately pass from the charged side, that which, to use a technical term, is electrified *positively*, to the other side, that which, from its deficiency of electrical matter, is regarded as the *negative* side, and both will be brought to an equilibrium. The passage of the fluid in this case is rendered obvious by the brilliant spark which it forms, and the noise which it causes. No quantity of matter, provided it be of a nature capable of favouring the current of the electrical fluid, can obstruct this passage, and the time occupied is not perceptible. Thus, if a person holding the end of a chain connected with the outside of a Leyden jar join hands with another, and this with a third, and so for a thousand, and the last in the circle thus formed touch the knob communicating with the inside of the jar, it will be

* Named from having been first used at Leyden. It consists of, *d*, a glass jar, coated with tin foil on both sides to a certain height, leaving a space uncovered: a metallic rod, terminated by a knob, *a*, descends through a glass tube, *b*, fixed in the cover, *c*, of the jar, and touches its bottom, which is coated.

discharged, and the passage of the electrical matter be sensibly felt by all the persons at the same instant. The extent to which this may proceed remains undetermined; but it has been ascertained, by actual experiment, that the charge of a Leyden jar has passed through a space of 1300 feet in a space of time too small to be appreciated. If, instead of the Leyden jar, a living being be placed on a stool with glass feet,



and hold a chain communicating with the prime conductor, electrical matter will be accumulated in his body, and sparks may be drawn from him in the same manner as from the prime conductor. The fact of electricity being thus accumulated in the person isolated is also proved by the gold leaf suspended from the cover, *a*, of an electrometer diverging, as at *b*, when his hand is held over it.

On this, the very threshold of our enquiry, the question arises, what is the cause of these phenomena? One reply only can be given: "Electricity is matter regulated by certain laws." Experience has taught us this, and also that the material cause of electrical phenomena is spontaneously excited by evaporation, by fusion, heat, and cold, and is also generated in some animals. This is strikingly illustrated in the torpedo, and the electrical eel, both of which have an apparatus, forming part of their living system, by which they possess the power of giving a shock, through the medium of the water in which they swim, sufficient to affect other fishes and animals that come near them: and this is a voluntary function.

The influence of electricity on the animal frame varies according to its mode of application.

If an individual, placed on an isolated stool, hold a chain passing from the prime conductor of an electrical machine, the electricity excited by the working of the machine passes into his body, and is prevented from passing out of it by the isolation of the stool on which he stands, or sits, cutting him off from communication with the conducting substances surrounding him. The electrical fluid is therefore accumulated in him; and his body will attract light substances, such as feathers and pieces of paper. Electricity, thus accumulated, increases the action of the heart and arteries, both in force

and velocity: and that this increase of the circulation does not depend on any mental feeling is obvious from the fact, that electricity may be applied to animals asleep, and in them the pulse is quickened. The temperature of the body is also augmented—a circumstance, however, not depending upon the heating power of electricity, but upon the increased velocity of the circulation. The increase of perspiration which always attends the electrification of isolated persons might also be regarded as referrible to the heating power of electricity; but this is not the case*. A clergyman, in whom I could never produce perspiration by any of the ordinary diaphoretics, and who never perspired by exercise, nor the heat of summer, when isolated and electrified, perspired freely. This effect on the skin has been ascribed to the power which electricity possesses of increasing the flow of fluids through capillary syphons; but, in the living body, it is more probable that it depends on the excitement extending to the extreme vessels.

Another method of electrification is the *aura*. When this is to be employed, the person who is to be electrified must be placed on a glass-footed stool; but, instead of holding the chain from the prime conductor, the electrical fluid is to be applied by connecting a pointed piece of wood, by means of a metallic chain, with the prime conductor of the electrical machine, and, having affixed it to an insulated rod, holding it about an inch or two inches from that part of the body intended to be electrified, while the machine is worked. A titillating sensation, resembling that caused by a stream of air, is felt upon the part; and, if the application be continued, both the irritability and the sensibility of the part are augmented.

If a metallic knob, affixed on a rod, be approached to the insulated person connected by the chain with the prime conductor of the machine, so soon as the knob is brought within an inch or even two inches of the body of the isolated

* The loss of weight by the perspiration induced by this means is greater than in ordinary perspiration. The Abbé Noillé electrified a cat for four hours, and found that it lost from fifty-eight to sixty-six grains. Plants transpire profusely when they are electrified. “J’ai vu,” says De Candolle (*Physiologie Végétale*, tome iii, p. 1094), des plantes perdre en quelques heures d’électrisation une quantité supérieure du quart ou du tiers à celle d’une plante non électrisée.”

person, a *spark* will be perceived: a sensation of pungency, also, is felt on the part, accompanied with slight muscular contractions; and, if the application be continued for some minutes, redness and inflammation are produced. This is more or less powerful, according to the distance at which the knob is held from the body; and the sparks are greatly diminished in size, if the part be covered with a non-conductor, as, for instance, a piece of flannel.

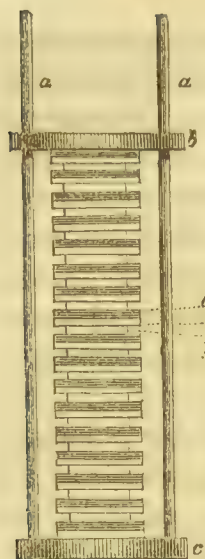
The *shock* is the fourth mode of electrifying. The body is made a part of the electric circuit through which the electric matter is to pass from one side of a Leyden jar to another. Thus, if a charged jar be held in one hand, and the other hand of the person holding it touch the knob of the wire communicating with the inside of the jar, which is charged positively, the electrical matter will rush from the inside of the jar and pass through the arms and chest of the person as its nearest way to the outside. If a number of persons join their hands, and a person at one extremity hold the jar, while another person at the other extremity touches the knob of the wire, the electrical matter must pass through all their arms and chests, and they will all feel the shock alike. To apply this to our purpose:—electric shocks may be given to any part of the body, without affecting the rest, by bringing that part only into the electrical circuit. If, for instance, the knob of the wire connected with the internal surface of a coated jar be applied to one side of the pelvis, and the extremity of a chain communicating with the exterior of the jar be applied to the opposite side of the pelvis, a shock will be sent through the pelvis; and, if the person be a female, the uterus will be powerfully stimulated. The sensation which it excites is unpleasant, and the muscular contractions are considerable. This mode of applying so powerful an agent requires caution, as animal life may be destroyed if the charge be considerable and the shock passed through a vital organ. The whole energy of the nervous system is suddenly exhausted, and immediate death follows. The bodies of animals thus destroyed undergoes rapid putrefaction, and the blood does not coagulate after death.

It has been supposed that the nerves are the parts of the

body which conduct better than any other ; and the truth of this opinion is supported by the discoveries in that modification of electricity which has been denominated Galvanism, and which, from some phenomena attending it, has given rise to an hypothesis, that the influence of the brain and nerves upon the muscles is of an electric nature. Even common electricity, sent along a nerve either in the living or the recently dead body of an animal, causes contraction of muscles, and, at the same time, in the living animal a sensation of pain is felt.

This modification of electricity is excited by chemical action, and it has received the name of Galvanism from its discoverer, Galvani, a Professor of Anatomy at Bologna. In 1790, the wife of Galvani, being consumptive, was advised by her physicians to take frog soup ; and, for this purpose, several of these animals were lying skinned on a table in Galvani's laboratory, near to an electrical machine. When the machine was in action, a pupil of the professor, who was amusing himself with it, happened to touch the nerve of the leg of one of the frogs with the blade of a knife : in an instant, the limb of the animal was violently convulsed. This circumstance was communicated to Galvani by his wife ; and it formed the foundation of a series of experiments which terminated in the discovery of this modification of electricity. For some time, however, although this new power was acknowledged to be electrical, yet it was attributed to the animal system, and consequently regarded as *animal electricity*. New experiments, particularly those of Professor Volta of Pavia, soon displayed the error of this opinion ; and, by meditating on the development of electricity at the surface of contact of different metals, Volta invented that instrument which is well known by the name of the *Voltaic pile**. This instrument (see marginal cut, p. 302) consists of a number of metallic discs, either silver and zinc, or copper, *d*, and zinc, *e*, of the same form and dimensions, and an equal number of discs of card, or cloth, *f*, soaked in salt water, of rather less diameter than the metallic discs. These discs are arranged in a specific order ; for example, on the top of the silver disc is placed

* Phil. Trans. 1800.



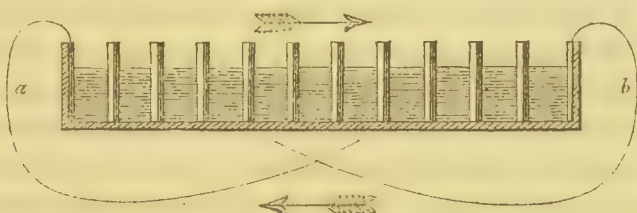
the zinc, and on that a card disc, until the pile is completed, which is kept together by the wooden frame *a, b, c*. If a finger of one hand be dipped in water, or rather in salt and water, and applied to the undermost or silver disc, and a finger of the other hand, similarly moistened, be applied to the uppermost or zinc disc, a distinct shock will be felt in the arms resembling that from a Leyden jar. If the cuticle of the fingers thus applied be abraded, a very acute sensation will be experienced in the fingers.

Notwithstanding these effects of the Galvanic pile, it was ill adapted for medical purposes; and, therefore, no progress was made in the application of Galvanism as a therapeutical agent, whilst the pile remained the only instrument for exciting electricity by chemical action; although its chemical effects were so powerful, that, with a pile of two hundred pairs of five-inch plates, Van Marum and Pfaff fused an iron wire twenty-eight inches long, and burnt platina wire when drawn out to a fine point.

In 1802, Dr. Wollaston having established the fact that the oxydation of one of the metals, the zinc, in the pile of Volta, is the cause of the disturbance of the electricity, and that its activity exists as long as the chemical action between the zinc and the fluid continues; the Galvanic trough, the instrument now employed for the application of this variety of electricity as a curative agent, was invented. Mr. Cruikshank, the inventor, constructed it on the principles of the Voltaic pile: the metal plates are arranged in the same manner as in the pile; and the only difference is, that, instead of moistened disks of cloth or of card, an acidulated fluid is introduced between each pair of the metallic plates, so as to bathe the zinc on one side and the copper on the other. Various modifications of this trough are employed for chemical purposes; but the trough, consisting of plates of a moderate surface, is still regarded as the best fitted for medical use. In this trough the electrical action becomes evident as soon as the acid fluid, which is a dilute solution of sulphuric acid

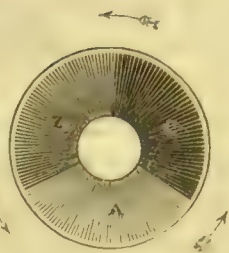


in water, with about $\frac{1}{30}$ of nitric acid, begins to oxidize the zinc. Whatever metals are employed in the construction of the trough, or whatever be the nature of the fluid used, the metal which is most energetically attacked is *positive* in reference to the other; and the current of the electrical fluid sets in the direction from it to the other, so as to establish a circle. Thus, if we suppose *a* to be a wire proceeding from the zinc plate, and *b* a wire proceeding from the copper plate, by bringing these together the Galvanic circuit is completed, and the current of electricity passes in the direction of the arrows.



Although the theory of Galvanism is still involved in obscurity, yet it has been accurately ascertained that the primary agent in the evolution of this species of Electricity is the force of *chemical attraction*. Now, assuming that this is true, we find that chemical action occurring between a solid and a fluid is always accompanied by the disturbance of the electrical equilibrium; and the natural electricity of the bodies is changed from a latent into an active state. Thus, if copper and zinc be placed in diluted sulphuric acid, the surface of contact between the zinc and the acid is that at which the chemical action and the development of electricity takes place, and the copper merely acts the part of a *conductor* between these two substances. This is the case in all the combinations of oxidizable metals, every metal being positive with regard to another metal which is oxidizable in a less degree: zinc, for example, is positive in reference to *iron* or *copper*; *iron* to *lead*, *copper* to *silver*; and so on.

The marginal diagram is well adapted to elucidate this subject. Suppose the letters A Z C the three elements essential to Galvanic action. "Between the two first of these, A and Z, some chemical affinity must exist adequate to produce combination and development of electricity; while the same degree of action is not exerted between the third element C and either of the former*." One of the two first bodies must be a solid and a conductor of electricity; and, as chemical action requires that one body at least should be in a fluid state, A must therefore be a fluid; whilst C may be either solid or fluid. It is requisite, also, that all these bodies be in mutual contact, so as to compose a circle. Now, if we suppose Z A C to be respectively zinc, acid, and copper, the surface of contact between Z and A will be that at which the chemical action, and consequent development of electricity, takes place*; and C will act only as its conductor. The current will therefore circulate in the direction of the arrows, or from A to C, and thence to Z.



Every circumstance which tends to facilitate the passage of the electric current in all parts of the circuit, tends to increase the quantity that circulates; the degree of conducting power, therefore, possessed by the fluid, has an important influence on the power of the apparatus: and the more readily a metal is acted on by liquid conductors, the less is the diminution of intensity which is sustained by the passage of the electric current through it.

This apparatus, the Galvanic trough, is the best instrument for the application of Galvanism as a medicinal agent. The effect it produces is more or less in proportion to the number of plates employed; but it does not follow that the greater the power the greater the number of the plates: on the contrary, a certain proportion exists between the number and the surface of the plates, to produce the maximum of power; and increasing either the size or the number, indefinitely, is

* See an excellent Treatise on Galvanism, published in the Library of Useful Knowledge, of which Dr. Rogett is the reputed author.

always followed by a diminution of power. A trough of fifty plates, each containing four square inches of surface, is sufficient for every purpose that can be expected from the influence of Galvanism as a medicinal agent. In using the trough, if shocks are to be given, the fingers should be dipped in salt and water ; but, if a stream of Electricity is to be passed through any part of the body, brushes dipped in salt and water are to be employed. One is to be held to the part of the body opposite to that at which the positive wire is to be applied, so that the current may pass in the ordinary circuit, the nerves forming the conducting media.

It is unnecessary, for our purpose, to say more regarding the theories of either modification of Electricity in its usual form ; whether it is excited by friction, or by chemical action : and, having explained the manner in which it can be accumulated in animal bodies, or abstracted from them, or passed through them as a part of the electrical circuit, it will be more useful to examine the physiological action of Electricity, and its influence as a therapeutical agent in the cure of diseases.

Electricity, whether common or Voltaic, applied to the animal system in a moderate degree, increases excitement ; in a large quantity, it destroys life. That it operates on the nervous system is shown in the production of sensation, by muscular contraction, and by altered secretion. In the same manner as with common Electricity, if any part of the human body be made part of the circuit of a Galvanic pile or trough, a shock is felt every time a connection is established with the poles of the trough, provided the skin be moistened. The shock resembles that from a large electrical battery weakly charged. The current, if continued, is all along accompanied with an aching pain ; and, if the cuticle be denuded, a sensation of burning or acute smarting is experienced ; and this is more severe when the Electricity flows out of the body, or is on the negative side of the pole. When an electrical current is passed along a nerve, distributed to any muscle of volition, the muscle is thrown into convulsive contraction, and the same effect results from Voltaic Electricity applied in a similar mode. Involuntary muscles are less easily affected by Electricity of either kind ; but they are not wholly

insensible to this Excitant. Its influence on secretion is rendered sensible by the changes it effects on the gastric juice. On the lower animals, smart shocks appear quickly to destroy life; but, on frequently passing gentle shocks through the heart of the animal thus apparently dead, oscillations of the muscles take place; and if these be continued for some time, the animal recovers; if they be too soon suspended, it relapses and dies. The vital organs are more excited by slight shocks than by strong shocks. Such are the grounds upon which Electricity has been employed in the treatment of diseases.

As an Excitant, electricity is most powerful, acting equally on the sensibility and the irritability of the system. It is highly diffusible; is quickly propagated over the system, and excites the action of the most distant parts: and, after its effects are produced, it leaves the body free from those secondary effects which more or less follow the action of other Excitants. As an Excitant, it is indicated in all diseases of debility. Much depends on the mode of applying it. In all cases, the simple *accumulation* of it ought to be first tried; *sparks* should next be taken; then the *aura* used; and, ultimately, when the body has accommodated itself to the Excitant, *shocks* may be given. In a very delicate frame, a strong shock may do mischief, by exhausting too greatly the excitability; thence, in nervous habits, it may not only induce syncope, pain, and vomiting of blood, but so exhaust the strength of the patient as to accelerate, and even cause death*.

Little benefit can be expected from a short continuance of Electricity, few cases occurring that do not require it to be continued for several weeks. Both internal and external medicines may be employed at the same time.

In intermittent and continued fevers, Electricity has been employed; but better and more speedy means of relief being in our power, it is not likely to be generally used in such cases. In some instances of atonic inflammation, as in scrophula, the sparks and aura have been found useful when continued for a quarter of an hour at a time, and repeated three

* Percival's Essays, vol. i, p. 393.

or four times a day. If the glandular affection be recent, the excitement restores the energy of the part and reduces the swelling; if in a more advanced stage, the suppuration is hastened, and equal benefit is derived. Hoarseness, arising from relaxation of the muscles of the glottis from repeated inflammatory attacks, has often been speedily cured by the daily use of the electrical aura. In gout, both sparks and the aura have been employed; but much caution is requisite; and still more in acute rheumatism. Indeed, in either of these diseases, Electricity may do harm. In the chronic form of rheumatism, much good, however, is obtained from it: sparks should at first be drawn through flannel; and, when rheumatism partakes of paralysis, gentle and frequent shocks be afterwards given. Electricity has been much lauded for the relief which it affords in sciatica; and there is little doubt, where this affection is rheumatic, that it may prove useful: but pains resembling sciatica arise from various conditions of the part; when there is phlegmonous inflammation, or when it is the attendant of affections of the kidneys and the urinary bladder, Electricity is more hazardous than beneficial.

In the neuroses, Electricity is the Excitant to be depended upon. Its good effects have been often observed in paralysis in all its forms: at the same time, although paralysis is a disease of debility, yet it has been occasionally seen connected with an opposite state of the system, as in sanguine and plethoric persons; and when the disease is at all accompanied with a tendency to determinations to the head, this agent should not be employed. Thence it is more likely to cure old and long-standing than recent cases of paralysis; partial, than general paralysis; paraplegia, particularly that kind arising from the poison of lead, than hemiplegia following apoplexy; and, generally speaking, it is well adapted for all cases depending on simple atony of the nerves. In these cases we should cautiously begin by isolating the patient, and continue the simple accumulation for a considerable time; then pass on to the sparks, aura, and shocks: but in each stage of our progress the change must be gradually made, and the new course begun with the greatest caution. Cases have occurred in which no benefit was received for five or six months,

and yet a cure was ultimately obtained. "Patients," says Dr. Percival, "are frequently discouraged, by the painful sensation which large shocks excite, from persevering in an electrical course:" but these are unnecessary; and our experience accords with the observations of this ingenious physician, that few cases "which resist the power of small and repeated shocks, yield to great and terrifying ones. There is an amazing difference in the sensibility of different constitutions to the electrical stimulus. Quick, lively people feel the most from it; those the least who are dull and slow of apprehension*." In the employment of Electricity, its powers are often greatly promoted by the use of external rubefacients.

In asphyxia, gentle shocks passed through the region of the heart have proved beneficial; and this is one of the diseases in which Electricity is always indicated. This, however, cannot be said of spasmodic affections, in which it has been much employed; but certainly without any very evident advantage.

In local affections, arising from nervous atony, Electricity is likely to prove beneficial. Thus it is useful in atonic deafness: but, in many instances, organic diseases of the organ have been mistaken for this condition of the auditory nerve, and no benefit has resulted from the Electricity. When the case is one adapted for the use of Electricity, sparks should be taken from the internal part of the meatus by a metal conductor passed through a glass tube: the effect is swelling of the part, with a flow of ceruminous matter; and in a short time the faculty of hearing is improved. Cases of thirty years' standing have been thus relieved.

In amaurosis Electricity has been employed: it proves useful when the disease arises from simple defective sensibility of the optic nerve; but if the cause be a tumor, or any other cause pressing on the nerve at its origin or in its course, little or nothing can be expected from Electricity. Sparks may be taken from the eye, directed through the back part of the head, following the course of the optic nerve.

In contractions and rigidity of the muscles, no remedy is

* Percival's Essays, l. c.

equal to Electricity ; and here both sparks and slight shocks may be employed.

In amenorrhœa, when other means fail, we may almost always resort with confidence to Electricity. It is especially indicated when the disease accompanies a pale leucophlegmatic condition of the habit. In this case, shocks should be passed directly through the uterus. Here it is easy to comprehend how Electricity operates independent of its general influence on the constitution. If we suppose that the deficiency of the uterine action depends on the atony of the organ, the excitement afforded by making it a part of the electrical circle in discharging the Leyden jar through the pelvis, will act exactly in the same manner as when moderate shocks are applied to any other organ ; the current of the blood will be determined to the uterus ; and its secretory power be consequently augmented. The visible effects observed in this employment of Electricity are, a copious flow of perspiration, a more than usually open state of the bowels, and deposits in the urinary secretion. In an opposite state of the system, however, when there is plethora and rigidity of fibre, with a high sanguine complexion, Electricity is a very hazardous remedy in amenorrhœa ; but even in this state of the habit, if antiphlogistic measures, bleeding and purging, be first employed, Electricity, cautiously administered, may produce beneficial results. The remedy should be at first used in the form of sparks, and shocks not resorted to until the sparks have been employed for a considerable time. In every affection of the uterine organ, before we determine on the use of Electricity, care must be taken to ascertain that pregnancy be not present ; as, in such a condition, either miscarriage, or, if the period be advanced, premature labour and the death of the fœtus, may follow its employment.

In uterine affections, where Electricity is even decidedly indicated, more than common caution is requisite ; the *sparks* should be drawn for a few minutes only on the first and second days ; and the period lengthened daily, in a manner proportioned to the nature of the disease and the temperament of the patient. In passing shocks through the uterus, much caution is requisite ; for, if inflammation or a tendency to it exist in the organ, dangerous results are sure to follow

the application of so powerful an Excitant. It is in cases in which there is evident diminished action that Electricity proves useful ; it is a stimulus both to the irritability and the sensibility of the living system ; but it must always be kept in remembrance that sedative effects follow its application ; and that these are the result of its stimulant powers exhausting the excitability ; the proportion and the quantity of stimulant power must therefore be regulated in the application of Electricity, for the same reason as in the employment of other Excitants ; if too powerful shocks be given, danger may result ; if too weak, no benefit will accrue from its use.

The effects of Galvanism on the animal tissues differ in some respects from those of common Electricity. On the skin it produces a sensation of burning, which, if the application of the agent be long continued, is followed by redness and tumefaction of the part. This sensation is more lively upon the lips, in the ears, and upon the globe of the eye, than on the hands which are defended by a thick epidermis. Like common Electricity, Galvanism accelerates the pulse, augments the secretion of the kidneys and of the skin, as well as communicates activity to the other secretions and excretions ; peculiar contractions are excited in the intestinal canal when one conductor is introduced into the mouth and the other into the rectum ; and when the current of the fluid is directed towards the brain, wakefulness, and restlessness, indicating much cerebral excitement, are perceived.

Galvanism has been more employed as a remedy on the Continent than in this country. Alibert tried its effects at the hospital of Saint Louis, in Paris, in purpura and other petechial eruptions, accompanied with great languor and anxiety. In one case, which had resisted every other means, the patient was completely cured in a month by the daily use of Galvanism ; the period of its application being gradually lengthened.

Although common Electricity has succeeded in chronic rheumatism, yet Galvanism has failed. It has been more successful in scrophulous obstructions and other diseases of diminished nervous energy. The only cases in which I have had an opportunity of observing its effects closely, are several of dyspepsia and asthma. In the dyspepsia of Asthma, I have

employed it in conjunction with Dr. Wilson Phillip, whose experiments on digestion led him to conceive that great advantage might be derived from the excitement afforded to the pneumogastric nerves by Galvanism ; but truth obliges me to say that, even as an auxiliary, its influence in this disease is very slight.

From the powerful influence of Galvanism in rousing the energy of the respiratory nerves, those of expression, in animals suddenly killed, and from the consideration of the function of the eighth pair of nerves as the chief agent in effecting the chemical change of the blood in respiration, and the deficiency of this change in asthma, I had formed sanguine expectations from the employment of Galvanism in this painful disease. The experiments of Sir Charles Bell have fully demonstrated the direct influence of the eighth pair of nerves in the chemistry of respiration, and that the other respiratory nerves, those concerned in the muscular movements of the diaphragm, intercostal and other muscles of the thorax, respond altogether with it in the performance of their functions : thence, when the oxidation of the blood, or rather its decarbonization, is not effected in a proper manner, the muscular energy is paralyzed, and suffocation is threatened. Again, if the par vagum be divided on each side of the neck, in a quadruped, the consequence is asphyxia and the death of the animal ; and whatever diminishes the influence of that nerve on the respiratory process tends to produce this effect ; whereas, the lesion of the phrenic nerves, the spinal, accessory, and external respiratory nerves, although it impedes the mechanical dilatation of the thorax, yet does not produce fatal effects ; and the function they perform may be aided by other parts being called into action. When the eighth pair of nerves is divided, in the lower animals, and asphyxia has supervened, from the circulation of uncarbonized blood, in both vascular systems in the lungs, if the continuity of the nerve be re-established by means of a Galvanic circle, we know that the blood resumes its arterial character, and life is maintained. The knowledge of these facts led me to form the most sanguine anticipations from the use of Galvanism in asthma : my experience has not confirmed my expectations ; and, in the greater number of instances, no advantage whatever has

resulted from its employment. On what does this depend ? is a question which naturally presented itself to my mind ; and I was led to examine more closely the pathology of asthma, both the humid and spasmodic variety. In the first, the effort required to excrete the redundant mucus is not of that kind which can be aided by Galvanism, the effect of which is more likely to produce an increase of the mucus of the bronchial tubes than a diminution of the overabundance. In the second place, with respect to spasmodic asthma, although it cannot be doubted that the sense of suffocation depends on the change of the venous blood not being properly effected in the lungs, yet it does not follow that the deficient energy of the eighth pair of nerves depends on defect of stimulus in that nerve. Convinced of the correctness of this view of the subject, and observing that, in cases in which the asthma was not of very long standing, the breathing was difficult in proportion to the degree of febrile excitement present, I was induced to believe that the theca of the spinal cord is more or less in a state of subacute inflammation, and, consequently, instead of the stimulus of Electricity, that I should recommend cupping over the dorsal spine. In very old cases, where the powers of life are much exhausted, Galvanism or Electricity may prove useful on the same principles as other Excitants.

The disease in which I have seen the most benefit obtained from the Galvanic stimulus is paralysis from colica pictonum ; and here, from the experience of several cases which terminated successfully, I can conscientiously recommend it.

b. CALORIC.

Caloric, like some other substances, is known to us only by its effects: it produces the sensation which we term *heat*. We therefore conclude that it is an Excitant, and further that it is matter. This latter opinion, however, has been doubted ; some philosophers maintaining that Caloric is merely a property of matter. It would be out of place here to enter upon this question : it is sufficient to say that the prevailing opinion favours the idea of the materiality of Caloric.

Caloric is unknown in its perfectly free or uncombined state ; for it pervades all bodies and passes from one only to

enter into another. For practical purposes, we may use the term *free* or *sensible caloric*, to imply that state of its existence by which its presence in any substance is obvious either to our senses or to the thermometer; and that of *combined* or *insensible caloric*, to imply that state of it in any substance which is neither evident to our senses nor to the most delicate thermometer. Thus, if a quantity of water, in a glass containing also a delicate thermometer, be placed in the open air, in a freezing day, and remain *perfectly undisturbed*, it will be cooled below the degree at which water usually freezes, and yet remain liquid; but, if it be then agitated, as much caloric will instantly be evolved, as if it were shaken out of the water, as will raise the thermometer to 32° , and the water will immediately freeze. In this case, the combined caloric of the water maintains its fluidity; but, when it is set *free*, on agitating the water, it at that instant becomes *free Caloric*, which raises the mercury in the thermometer, whilst the water, having lost the Caloric that maintained its fluidity, becomes solid or frozen. Again, a quantity of ice, in a pan placed on the fire, melts, but does not raise the thermometer above 32° until the last portion of the ice be melted. In this case, the Caloric which flows from the fire becomes insensible, or is combined with the water to maintain its fluidity; and only the redundant Caloric, received after the whole is melted, becomes sensible to the thermometer. But different bodies, at the same temperature, contain different quantities of Caloric: this is termed the *specific Caloric* of bodies; and many ingenious experiments have been made to determine the quantity contained in various bodies*. It is of importance, for our purpose, to trace the sources of Caloric.

One source of Caloric is the sun: but whether the Caloric which reaches the earth's surface in combination with light be emanated from the sun with the particles of light, or whether the particles of light acquire the Caloric in their passage

* The specific heat of the solids and fluids of the living body is less than that of water: the quantity of combined Caloric, therefore, in the whole human body is rather less than in an equal quantity of water at the same temperature; for the inferior capacity of the venous blood more than counterbalances the superior capacity of the arterial blood.

through the earth's atmosphere, it is impossible for us to determine. The temperature produced in bodies by the direct rays of the sun seldom exceeds 120° Faht.

Combustion is another source of Caloric. It is unnecessary, for our purpose, to enquire whether the heat and the light thus produced arise from the simple union with oxygen of one or more parts of the combustible body, as Lavoisier supposed; or whether, according to Brugnatelli, oxygen unites with bodies in two states: namely, one in which it retains the greater part of the Caloric and light which it contained in its gaseous state; the other, in which the union takes place only after it has parted with these: or whether it is an electro-chemical phenomenon, as Berzelius has supposed. I will not, therefore, pause to examine the theory of this process, during which both light and heat are largely emitted, and rendered subservient for stimulating the animal body, in a degree proportionate to its necessities.

Percussion is another source of Caloric. It is well known that a rod of iron, rapidly hammered, becomes red hot; and that sparks are elicited by striking flint upon steel.

Friction is a very important source of Caloric. It is produced in organized as well as in unorganized bodies by this means; but it is not easy to explain why Caloric is accumulated by friction: something is supposed to be due to the agency of *electricity*.

Mixture is another source of Caloric. This is owing to the specific gravity of the mixed body being greater than the mean of its components; as when strong sulphuric acid is mixed with water.

The last source of Caloric is *Electricity*. The spark elicited in discharging an excited body through the air fuses metals and sets fire to combustible bodies.

The chief sources of Caloric, for medicinal purposes, are *combustion* and *friction*. But Caloric is generated by living animal bodies; and it is this faculty which enables man and other animals to resist the extremes of heat and cold. As this is a vital process, it is greatly influenced by the state of the nervous system; but it is, possibly, immediately dependent on chemical changes going on under the influence of the

vital powers. In this country, the lowest average heat of the human body is 88° ; its greatest heat, in the state of disease, 110° .

With respect to the *distribution* of Caloric, bodies which contain more free Caloric than the air and other bodies that surround them emit it and continue to do so until the whole come to an equilibrium. This power of Caloric to be *communicated* from one body to another varies according to the nature of the body communicating it: that body into which it most rapidly enters communicates it also most rapidly: and it is on this account that bodies of the same actual temperature give a different sensation to the touch: thus, a piece of flannel, a piece of leather, and a piece of iron, all of the same temperature, will seem cool, cold, and coldest, in the order named; the flannel cool, the leather colder, and the iron coldest.

The Caloric is given out in straight lines or is *radiated*: the manner in which this is effected is regulated by laws which it is not my province to explain, but the knowledge of which is important to the physician. Thus, by knowing that surface affects the radiation of heat, if I wish to apply heat by means of hot water rapidly to the living body, I would put the hot water into a tin vessel painted black and covered with linen; if I wish to convey the heat more slowly, but to keep it up for a long time, I would put the hot water into a *bright* tin vessel without any linen around it.

When Caloric enters into a body, it is accumulated to a certain extent within it, and increases its bulk; but the body is capable of combining only with a certain quantity of Caloric without changing its state—a circumstance regulated by or according to the conducting power of the body. Solid bodies are the best conductors; gases the worst; but all solids, all fluids, and all gases, do not conduct alike. Metals are the best conductors, as may be easily proved by holding a rod of metal and a rod of glass, of the same diameter and length, in the flame of a lamp: the iron rod will become so hot, in a few minutes, as to prevent it from being longer held; whilst the glass rod may be held in the hand until it is nearly all melted away. The small conducting powers of silk, wool,

and feathers, admirably adapt them for clothing, as they do not permit the Caloric which is generated in the body to be rapidly carried off by the cold external air.

Animal bodies are bad conductors; thence Caloric is slowly diffused through them: a circumstance which enables us to employ caloric advantageously in the form of *baths* and *fomentations*.

Such is Caloric: as a therapeutical agent, the following facts are all that are required to be known regarding it. 1st. That it is a material body or substance, contained in all organized and unorganized bodies: 2d. that when it is contained in a larger quantity in a free state in any body than in other surrounding bodies, radiation takes place, and it passes from it into them: 3d. that it increases the bulk of all bodies into which it passes: 4th. that it becomes free or sensible when bodies pass from a gaseous to a fluid, and from a liquid to a solid state, and vice versa: 5th. that it passes through various bodies with different degrees of velocity: and, finally, that on entering the living animal body, it excites the nerves of sensation. Let us now enquire into its action, as an Excitant on the living animal system.

On the living body, the first effect of Caloric, in the free state, is to stimulate the nervous system, augmenting the irritability and exciting motion. This is obvious, even in the earliest stage of organization, as Harvey demonstrated by his experiments on the egg. In a low temperature, the punctum saliens, or vital speck in the egg, beats slow and languidly; in a higher temperature its motion is more vivid; and this alternates according as the Caloric is abstracted or applied. It is on this account that both plants and animals arrive sooner at maturity in the torrid zone: there women become mothers at ten and twelve years of age; in Lapland, not until they are twenty-four. But the excitement caused by Caloric is soon followed by debility and exhaustion; thence the inhabitants of the torrid zone are more languid and feeble than those of temperate climates.

Caloric, when applied to the living body, in a degree above 68° Faht. increases the secretions in quantity, and alters them in quality. Thus, perspiration is greater in a warm atmosphere

than in a cold ; its chemical properties also are changed ; it becomes more acrid ; and, when a European first visits any country within the tropics, this acrimony displays itself in a cutaneous eruption, *Eczema solare*, or prickly heat. The augmented excretion of the skin lessens the secretion of the kidneys ; the urine becomes highly coloured, and contains more salts in a given quantity : thence diseases of the urinary organs are more frequent in warm than in cold climates. In the alimentary canal also, the secondary effects of caloric are felt : true dyspepsia supervenes, and Excitants, which Nature has bountifully provided in these climates, become necessary for sustaining the tone of the system. The liver, also, becomes affected in an increased temperature, long continued, particularly in those who go from colder to warmer climates : the biliary secretion is augmented in quantity, and its character altered from the hurried manner in which it is formed. Thence cholera and hepatitis are the prevailing diseases of warm climates. Heat is also the most general predisposing cause of fevers, by increasing the irritability of the system, producing debility, and thence inducing a vitiated state of the secretions ; which, reacting on the habit, produce febrile action. Several of the phlegmasiæ, besides hepatitis, are also produced by the direct influence of heat, and are endemic in warm climates. Tetanus is another disease of the torrid zone, depending on increased irritability arising from the continued impression of heat. Dyspnœa is often the result of a hot atmosphere.

Besides increasing the irritability of the system, the introduction of Caloric into it augments, also, its *sensibility*. When Caloric passes into the living body from a heated body, it produces the sensation of heat ; and, at the same time, renders the body more susceptible of every other impression.

The intensity of sensation from the introduction of Caloric into the body depends on three circumstances—1. the state of the sentient nerves ; 2. the velocity of the impinging Caloric ; 3. the nature of the conducting medium. The influence of the state of the sentient nerves is daily demonstrated. A body of a temperature under 60° will convey the sensation of warmth or of coldness, according as this temperature be

higher or lower than that of another body which had been just previously touched: as, for instance, if the hands be put into fluids of different temperatures, say 36° and 96° , and then both plunged into water at 60° , to the hand which was in the water at 36° the water at 60° will feel hot, whilst to the other, which had been in the water at 96° , it will feel cold. With respect to the influence to be attributed to the rapidity with which the Caloric flows into our bodies, much depends on the conducting power of the substances applied to the body: if mercury be taken as the standard, and reckoned as 1000, we shall find dry air to be 80, moist air 330, and water 343*. Thence water and air of the same temperature produce very different sensations on the body: thence, also, from the greater conducting power of moist air than that of dry air, we feel cold in damp weather of the same temperature as that which produces an agreeable feeling of warmth when the air is dry: and, if the atmosphere be agitated by wind, we feel colder than would be the case from the actual temperature of the air. On the same principle, we are more sensible of the impression or the abstraction of Caloric from metals, than from wood of the same temperature.

Let us, now, consider the value of Caloric as an Excitant, when applied through different media. Caloric may be applied to the living body through *aeriform media, including vapours; fluid media; and solid media.*

1. *Aeriform media.*—When the body is exposed to dry, highly heated air, the Caloric operates as a powerful Excitant, producing headache and accelerating the pulse. This effect is daily proved in the Russian hot baths; in which the patient is first exposed to dry hot air before the vapour is introduced. In our climate the medium temperature of the air is 62° Faht.; but it does not act at this degree as an Excitant, nor is its influence as such permanently felt until it reach 98° . At this temperature the sensibility and general energy of the nerves, and the action of the heart and arteries are increased; and, as the last effect extends to the cutaneous capillaries, the perspiratory function is also rendered more active; and thence therapeu-

* Experiments of Count Rumford.

tical effects follow, which I shall afterwards notice. There are states of the body also in which the direct application of hot air may prove beneficial: thus, in cases of suspended animation from drowning, as hot water is not always ready, hot air may be employed in its stead: and it is a ready and excellent means of communicating external warmth to the body in the cold, blue condition of it which characterizes the state of collapse in Asiatic cholera. To apply this agent, the body must be laid on a mattress, raised at one end so as to form an inclined plane, covered with a blanket; and the blankets, or other bed clothes, instead of coming in contact with the body, should be elevated over it, by means of three or four half hoops: a spirit lamp should next be introduced at the bottom, so as to produce a current of heated air, which, involving the body, produces a very powerful exciting effect. In order to increase the stimulant power of hot air baths, sulphur and other substances of a volatile nature are employed, and form part of the heated atmosphere with which the patient is involved. Baths of this description have of late years been much used for the cure of some cutaneous eruptions, and obstinate cases of chronic rheumatism.

Although the body is less capable of resisting the same degree of temperature in moist air than in dry air, yet a much higher temperature can be borne in *vapour* than in *water*. Those accustomed to the use of the vapour-bath—for example, the Russians—can sustain vapour at a temperature of from 120° to 130°, some even to 160° Faht. This mode of obtaining the exciting effects of Caloric has been long employed by the Oriental nations: the simplest method of applying it is practised by the Hindoos. The patient is stripped naked; and, a blanket being pinned round his neck, so as to envelope the whole body, he is seated on a low stool: an earthen vessel, containing some leaves of no importance, is then introduced within the blanket; and, boiling water being poured into this vessel, the opening of the blanket is well secured by pins. In a few seconds, the patient begins to feel the warm vapour encompassing his body and his temperature increasing, until the system relieve itself by a copious perspiration. If it be requisite to maintain the effect, hot bricks are thrown into the

water at different intervals, so as to renew the supply of vapour. The chief recommendation of this bath is its simplicity; and it can be employed at the bed-side of a patient; for, contrary to what might, a priori, be expected, it does not even wet the floor of the apartment.

But no vapour-baths, to produce a powerful effect, are equal to those of the Russians. In St. Petersburg, they are on the most magnificent scale, emulating those of ancient Rome*.

In the vapour-baths in St. Petersburg, the first or outer room, in which the bather undresses, is seldom of a temperature under 120°: at first, this dry heat produces a slight headache and an uncomfortable feeling; but this excitement is soon relieved by a general perspiration; and the heat of the apartment gradually becomes more tolerable. The bather is then introduced into the bath-room, the temperature of which is from ten to twenty degrees higher than that of the outer room; and this increases as the bather ascends different benches, ranged one above the other. He first seats himself upon the lowest bench, from which, after remaining for a few minutes, he ascends to the second, and so on, till he almost attains to the ceiling of the bath, where the temperature, to any one not accustomed to this luxury, is insupportable. The head now feels oppressed and burning; the skin is hot; the respiration difficult: indeed, as the air is perfectly dry, the effect is the same as might be felt in an oven. The attendant, who is termed in Russian the *Parilstchick*, now feels the skin of the bather; and, if it be

* Gibbon thus describes these splendid edifices: "The baths of Antoninus Caracalla, which were open at stated hours for the indiscriminate service of the senators and the people, contained above sixteen hundred seats of marble; and more than three thousand were reckoned in the baths of Diocletian. The walls of the lofty apartments were covered with curious mosaics, that imitated the art of the pencil in the elegance of design and the variety of colours. The Egyptian granite was beautifully encrusted with the precious green marble of Numidia; the perpetual stream of hot water was poured into the capacious basins, through so many wide mouths of bright and massy silver; and the meanest Roman could purchase, with a small copper coin, the daily enjoyment of a scene of pomp and luxury which might excite the envy of the kings of Asia." From these baths the Romans issued, steaming with perspiration, and plunged into the Tiber, in the same manner as after the violent exercises of the Campus Martius.

not bedewed with perspiration, he opens the door of the stove and throws into it a bucket of water. The atmosphere of the bath is instantly pervaded with clouds of vapour; and, in a moment, a deluge of perspiration streams from every pore of the skin; the breathing is relieved; the headache disappears; and a general sensation of pleasure is experienced. The relaxation which follows this application of the Caloric may readily be conceived: a sort of shampooing, with soap-suds and the inner bark of the lime tree, is now assiduously performed by the *Parilstchick*, pressing on every joint: and the operation terminates by dashing tepid or cold water, at the pleasure of the bather, over the body. The Russians, who use this bath at least once a week, are not contented with the highly exciting power of the Caloric, but have the body whipped with twigs of birch, with the leaves on them, which are publicly sold at the doors of the baths; and the poorer Russians, in the state of profuse perspiration, rush out of the bath, roll themselves in the snow, and then return to finish the bathing. The benefit derived from the use of these baths can be attributed only to the Caloric in the first instance exciting the heart and arteries, and afterwards equalizing the circulation by the force with which the blood is thrown into the capillaries. The glandular system is also powerfully stimulated; the secretions are facilitated; and a general impulse is given to the nervous energy.

2. *Fluid media*.—Caloric, combined with water, is employed as an Excitant in the form of warm and hot baths.

Warm baths have been used from time immemorial as an article of luxury; and they have been imposed as a religious duty upon some nations; for instance, the inhabitants of Asia. Indeed, as the Asiatics, living in a warm climate, wore sandals, and woollen garments which were seldom changed, the use of the bath was as necessary for the preservation of their health as food for their sustenance. The ablutions, therefore, enjoined by the laws of Moses, and those of Mahomed, were wise and salutary. In modern Europe, the use of the warm bath, except in Russia, can scarcely be regarded as general; and it is viewed rather as the means of removing diseases than of preserving health.

Water, at the same temperature as air, feels warmer to the body, merely because it is a better conductor than air: at a temperature, therefore, higher than that of the body, water rapidly communicates Caloric; at a temperature beneath that of the body it as rapidly abstracts it. Water feels cool to the surface, on first immersing the body, if the temperature do not exceed 87°. At this temperature, it does not prove an Excitant; and therefore no bath is termed *warm* until it exceed 87° Faht. Water, at various temperatures, even above that of boiling, is found in a state of nature, constituting natural *warm* and *hot* springs.

When the body is immersed in the *warm* bath, whether natural or artificial, at a temperature not below 98°, an agreeable sensation of warmth is perceived, the veins on the surface swell, the bulk of the body is sensibly increased, the skin becomes redder than natural, it also softens, and minute scales separate, the action of the heart is augmented, the pulse feels soft and full, but beats quicker; as soon, however, as the person rises from the bath, sweat breaks out, and languor and debility follow; and this even occurs, when the person is in the bath, on those parts of the body not surrounded with the water. These effects proceed partly from the immediate impression of Caloric on the sentient nerves of the skin, and partly from this first impression producing a state of the capillaries which, at the moment, is inconsistent with the perspiratory function—a state somewhat approaching to that of the extreme vessels which checks perspiration in acute fever: but the degree of heat being inadequate to maintain this effect, and the water, now that the temperature of the skin is greater than itself, acting as a cooling medium, relaxation follows; and therefore the warm bath, in its general action, is a cooling agent. On the same account, the warm bath has a peculiar tendency to alleviate irritation and consequently to induce sleep.

When the *hot* bath is employed, that is, when the body is immersed in water of a temperature between 100° and 108°, or as high as the individual can bear it, the effects differ only in a degree: the heart and arteries being more excited; the face, as well as the rest of the body, becomes red; the

temples throb, and the pulse is felt, even at the finger-ends. The collapse, however, is proportional to the excitement; and, consequently, much greater after the hot than the warm bath. We may regard the warm bath a moderate Excitant, when the immersion is not prolonged beyond eight minutes; but, beyond that time, a relaxant and sudorific: the hot bath is strictly stimulant.

The first effects of the bath, independent of the impression which it produces on the nerves of sensation, are the same as would be exerted on inanimate matter. The caloric expands the bulk of the body: but, whilst we are convinced that the bulk of the body is increased, by our clothes feeling tighter than they were before, after having been in the warm or the hot bath, yet it is uncertain to what part of the frame this increase of bulk or expansion takes place. Sauvage exposed the blood to various temperatures, from 32 to 112, and found that it experienced no mensurable increase of bulk; and, even between 112 and 212, the increase of volume did not exceed $\frac{1}{300}$ th part: the result of Haller's experiments was the same. Neither does any increase take place in the solid living fibre; we must, therefore, refer it in part to the elastic fluids contained in the blood and other parts of the body. Something is also due to the diminished resistance of the skin relaxed by the bath; and this accounts also for the greater enlargement of the veins than of the arteries; for, as the veins are more superficial, and scarcely contractile, the greater afflux of blood thrown into them by the increased action of the heart and arteries produces in them a temporary congestion and enlargement.

Is any of this increased bulk due to the absorption of water? The experiments of Dr. Currie first threw a doubt on the absorption by the skin. He supposed that no absorption could take place unless the skin be eroded by friction; and, if any increase of weight take place, that it must depend on absorption by the lungs. After an hour's immersion in the Buxton bath, at a temperature of 82°, he found that the weight of the body was rather diminished than increased. Many experiments of Seguin seem to confirm this opinion, and to prove that the great impediment is the cu-

ticle ; for if this be removed, absorption goes on. Dr. Rousseau of Philadelphia has nevertheless demonstrated, that the skin possesses the function of absorption in a small space (Part i, p. 9) : but numerous well-conducted experiments exclude all idea of cuticular absorption ; and, consequently, the question of increase of bulk from this cause must be answered in the negative.

The warm bath, also, softens and smooths the skin. The exterior part of the cuticle rubs off in the form of scales, which are in a partial state of decomposition ; for the water used as a bath, in which they are mixed, putrefies rapidly. By the removal of these scales, the function of perspiration becomes freer than before ; thence one cause of the benefit derived from the use of the warm bath, even to the healthful. With regard to the effects of the *warm* and *hot* baths on the living system, it requires no acuteness of observation to be convinced that the stimulus they impress must necessarily be in the direct ratio of the temperature of the bath.

It is to the influence of caloric on the irritability of the system, that we are to attribute the increased action of the heart and arteries in the warm and hot baths. But in what ratio is the arterial action accelerated ? In the warm bath, the pulse, at first, is seldom below 96° ; but, after some time, this diminishes ; and, if the immersion be long continued, it sinks below 68°. In a bath heated to 104°, Dr. Parr found the pulse increase both in vigour and frequency after the person had been immersed for twenty minutes : and even after half an hour, in a bath at 102°, the arteries beat violently to the ends of the fingers ; the breathing became laborious ; the vessels turgid ; the face flushed ; and sweat broke out. In water at 106°, the velocity of the pulse was greatly increased ; in five minutes vertigo supervened ; and the most copious sweat followed. In fifteen minutes after the use of the bath, the patient being in bed, the pulse returned to its natural standard of velocity ; but it remained full for some time. From these facts we may conclude, that the arterial action is augmented in the ratio of the temperature of the bath, and the time in which the patient is immersed ; and that, consequently, excitement or relaxation may follow the use of the

same bath. To obtain the first, the patient must remain a short time only in the bath; for the second, the immersion must be protracted.

The natural baths which come under the denomination of warm and hot baths, are those of Bath, the temperature of which is from 96° to 106° , although the water issues from the spring at 116° ; those of Vichy and Barege, the heat of which is 120° ; of Borset, which is 132° ; Aix-la-Chapelle, which is 143° ; and Carlsbad, which is 165° . But, in this country, both *warm* and *hot* baths are generally artificial, and much ingenuity has been expended in inventing easy means of heating water for the purposes of baths.

The partial means of using warm and hot water are various. The partial baths are—1. the *semicupium*, or half bath, in which the lower limbs and the trunk, as far as the hips only, are immersed: 2. the *Balneum coxæluvium*, or hip bath, which, as its name implies, is fitted to receive the hips only, and has the advantage of requiring very little water; as the bulk of the parts immersed, in proportion to the size of the bath, raises the water on each side so as completely to cover the hips: 3. the *pediluvium*, or foot bath, which takes in both the feet and the lower limbs, and which should always reach as far as the knees: 4. the *manuluvium*, or hand bath; which, in general, should be used at the same time as the foot bath, when the intention is to relieve the head or the chest by counterirritation*: 5. Fomentations, by means of flannels wrung out of hot vegetable decoctions, and hot water: and 6. that mode of applying hot water which the French term *la Douche*.

The five first of these partial baths all influence the habit nearly in the same manner as the general warm or hot bath, varying in their effects according to the temperature at which they are employed: but some remarks are necessary to be made on the other two, as the principles on which their

* A very important improvement might be made in the vessels employed for these partial baths, by making them double, so that a layer of air, which is a bad conductor, would be interposed between the water in the bath and the external air.

effects are produced, and the mode of applying them, seem to be but little understood.

The simplest kind of fomentation is a flannel cloth or sponge, soaked in hot water, and wrung or squeezed dry before being applied to the part which is meant to be fomented. In what manner does this operate? Here we must have recourse to our knowledge of the laws that regulate the action of Caloric; and we find that those substances, being spongy and involving much air, are bad conductors of heat; that they therefore cool slowly, and thence enable the Caloric, in conjunction with aqueous vapour, to be applied for a time sufficiently long to prove beneficial. It is customary to use vegetable decoctions, such as chamomile flowers and poppy heads, with the flannel and sponge; and, although it is pretty clear that these substances are not absorbed, yet it is equally certain that decoctions of poppy heads add much to the soothing effects of fomentations; apparently from their influencing the nerves of the skin, and the connection between the skin and the internal organs. A greater quantity of Caloric can be applied in fomentations than can be borne either in the form of water or of vapour as a general bath; but it cannot be so long maintained. The temperature of the flannels should not be under that of 100° Faht.; and, when applied, they should be protected by dry flannel cloths laid over those used to convey the Caloric, to moderate the cooling of the fomentation. If we set aside the two narcotic vegetables just mentioned, the addition of vegetable substances rather tends to diminish the power of fomentations than to increase it. The flannels should be formed of at least three yards of the stuff in the length of the web, and the ends should be sewed together: they should be quickly wrung dry by sticks passed through them, and turned in opposite directions; then applied as lightly as possible over the parts to be fomented; and the whole enveloped in dry flannel. Our knowledge also of the radiating powers of Caloric is necessary to direct us to the choice of the colour of the flannels to be employed. Thus, if I wish to apply a sudden heat, caring little as to its permanency, I should chuse black or dark flannels; but if I wish

to apply a moderate long-continued heat, I would chuse white flannel in preference. Poultices are merely modifications of fomentations. They may be made of any substance that is soft and spongy ; but the best material is linseed meal and boiling water. They should be light, and rather frequently repeated than bulky. The most ancient poultice on record was made of figs, which also form an excellent poultice. It was employed for the relief of Hezekiah, one of the Kings of Israel, who lived 260 years before Hippocrates. The passage is in the Second Book of Kings, in the twentieth chapter and seventh verse—" And Isaiah said, take a lump of figs. And they took it and laid it upon the boil, and he recovered."

The last local mode of applying Caloric in combination with water, is the partial effusion of hot water, or *la Douche*, as the French term it. The principle of its operation is certainly not understood. It consists in pouring upon the limb to be douched, water at a temperature within the limits which I have described as constituting the warm bath ; and at the same time applying friction to the part. Experience has sufficiently demonstrated the beneficial effects of this method of employing warm water in chronic rheumatism, sprains, and rigidities of the joints. As it may be regarded as a modification of friction at a given temperature, much of the benefit will depend on the magnitude of the column of water and the height from which it descends. The sensation is that of fatigue in the part submitted to the *douche* ; and this is followed by relaxation not only of the rigid limb, but, if the patient be properly managed and a general effect is required, by relaxation of the whole system.

The difficulty of applying Caloric in combination with water in this manner, in private practice, is the almost impossibility of getting the stream of warm water of a sufficient magnitude, and the fall of a sufficient height. Nature has furnished the douching warm baths in several parts of the world : among the most justly celebrated, are those at *Aix les Bains*, in Switzerland ; the method of using which is so well described by Mr. Bakewell, that I make no apology for quoting his description nearly at length. "Till the year 1772," says Mr. Bakewell, "the sulphur bath at Aix les

Bains was merely a large cave cut in the rock, and divided by a wall into two apartments, one for the men, the other for the women, with an iron balustrade in front. At that time the King of Sardinia caused the present handsome building to be erected and fitted up, expressly for the operation of douching. Each bath, or cell, is an arched vault, about thirteen feet long, eleven wide, and twenty-two feet high from the top to the place where the patient sits. There are two apertures, or short tubes, by which the water descends in columns, as large as the arm, from the height of from eight to ten feet; it is carried off by channels in the floor, and runs down into the street. There are two men, called *douchers*, constantly in each cell; and two women *douchesses*, in each of the women's apartments. Porters are also in attendance to carry the patients in chairs provided by the establishment. These chairs are placed on poles, with cotton hoods or curtains, so as entirely to cover the patient.

“It is the general custom to begin by taking one or two warm baths at home. To persons who take the douche for the first time, the process is rather formidable. On entering the cell, when the door was closed, I seemed in darkness, and involved in dense vapours and sulphurous odours; but as my eyes became accustomed to the gloom, I could discern a feeble glimmering of light, entering by a little wicket above the door, covered with canvass. I then discovered two silent and nearly naked figures whom I had not before perceived, standing with their bare arms extended, as if ready to seize me the moment I was undressed. It would have required no powerful aid of the imagination, in such a place, and amid the gloom and sulphurous vapours, to have transformed these figures into demons or tormentors of the Inquisition; and the horrid yells of the douchers, in the neighbouring cells, to call the porters, might have confirmed the belief. On approaching the flight of steps where I was to descend to take the douche, I drew back my foot, as I could not see where to set it down. ‘This they attributed to fear, and cried out, ‘N’ayez pas peur: soyez tranquille; nous vous menagerons doucement comme un enfant gâté.’ They then brought me under one of the streams of water that issue from near the top of the cell, and

told me to extend my hands in order to break the column of water, and distribute it over my body, as it would be too painful and scalding if received at first in one stream. When I had stood under the water a little time, I became accustomed to the heat. I then sat down, and the process of douching commenced. The water is made to pass through long jointed tin tubes, which are fixed on the two apertures where the streams enter. Each doucher takes one of these tubes, which he directs to different parts of the body on which the water falls.

“The first morning, the douching continued only five minutes: but the time was increased each succeeding morning till I was able to bear the operation for twenty minutes or half an hour.” Mr. Bakewell proceeds to describe, in a very amusing manner, and with graphic truth, the mode in which the porters attached to the baths carried him, rolled up in flannel, more like a corpse than a living man, to his bed room; and, leaving upon him the wet sheet in which he was first wrapped by the douchers after the operation, placed him in bed. The effects of the douching are thus described:

“A profuse perspiration immediately succeeds, and generally continues till your attendant comes to release you from your confinement, warm your linen, and assist you to dress. Half an hour was considered sufficient in my case; but, for rheumatism or palsy, the patients sometimes remain in bed three or four hours. The operation is painful and very exhausting: it may be aptly compared to purgatory, when all the peccant humours are to be expelled by the continually modified agency of fire.”

Notwithstanding the high temperature in which the douchers remain for so many hours daily during the season, yet they are in excellent health*. The season for douching is from the middle of June till the latter end of September. Before or after that time douching is considered dangerous; the mornings and evenings being generally cold. It is seldom that a patient remains longer than a month at Aix; the

* One remarkable fact is mentioned by Mr. Bakewell regarding the health of the douchers. “One of them,” says he, “told me that he commenced douching at three o’clock in the morning, and should continue till noon.” This was a fat old man who had been a doucher for thirty years.

operation being too severe to be longer continued without intermission: and the physicians generally recommend an intermission.

I have quoted this passage from Mr. Bakewell's Travels, not merely because the subject of it, in strictness, belongs to our present enquiry, but because Nature, having provided the means of carrying on this operation in a more perfect manner than can be effected by art, has also suggested several circumstances, in the conducting of it, which are overlooked in performing the operation of douching in this country. Now, let us consider what these are, and, as far as it can be effected, improve upon her model. In the first place, those streams of hot water flowing into caves or cells in the rocks, the atmosphere of the place in which the operation is performed is imbued with moisture, at a temperature which we must suppose—for Mr. Bakewell has not mentioned it—nearly equal to that of a vapour-bath, within the moderate range. This, as it were, prepares the body for the douching, which, as I said before, can be regarded only as a peculiar method of applying friction to a part in combination with caloric and water. In the second place, the fall of the column of water being from such a height as to produce a sensation of pain, followed by fatigue, and the benefit resulting from this being so obvious, we ought, in artificial douching, if I may so express myself, to imitate this by percussion with some elastic substance, as, for instance, a ball of cork affixed on a handle of cane. The pump at Bath is a species of Douche.

The temperature of the baths of Aix les Bains is 110° ; but this temperature, which is above the moderate range, is diminished by the fall of the water in the douching cells: be this as it may, a temperature not exceeding 98° , with percussion, is adequate to fulfil every indication that can be expected from douching*.

3. *Solid media*.—With regard to the application of Caloric

* I have successfully applied my suggestion on this subject to practice; using a cork ball covered with kid leather, and fixed in a whalebone handle to give the blows, whilst the hot water is poured on the part from a height of three or four feet.

through a solid medium, little requires to be said. It is conveyed by means of salt, bran, bricks, and metallic plates, which are wrapped in flannel or linen according as the Caloric is required to be slowly or quickly transmitted: and this is regulated, not only by the nature of the conducting medium, but also by the colour retarding or facilitating the radiation of the free Caloric. This mode of applying Caloric is more directly stimulating than any of the other methods; and is therefore more generally resorted to in local affections, such as sudden attacks of a spasmodic kind, either of the heart or of the stomach. When the mere exciting effects of Caloric are required, the solid medium is preferable to that either of air or of any fluid, as it is not followed by perspiration and relaxation.

In the practical application of baths, some cautions are necessary to be attended to.

In the first place, before employing the warm bath in any form, we ought to consider what effect we wish to produce; as we are well aware that the effects of the *warm bath* and the *hot bath* are perfectly different. If the stimulant effects only are required, the *warm bath* may be used for a short space of time; or, if a high degree of excitement be required, then we must have recourse to the *hot bath*. Within the range of these two, from 87° to 108° , we may regulate the stimulus to the necessity of the case: above 108° there is considerable risk; and even at 106° it must be used with much caution; for, when the temperature is so high, if no sweat soon follow, a corrugation of the skin ensues, the perspiration and cooling process are stopped, and the system suffers from accumulated Caloric. When a high temperature, therefore, is required, the vapour-bath should be employed. In deep-seated diseases, the temperature of the bath should be considerably above that which is necessary for relieving superficial affections; but, in this case, topical and partial baths are preferable to the general bath, as in them the heat may be carried to the verge of vesication. The exciting effect of these local baths or fomentations may be further augmented by friction and percussion.

If the exciting influence of the bath is intended to be tran-

sitory, and to be followed by relaxation, the temperature should not exceed 98°, and the bather should remain in the water at least half an hour. To secure the sudorific effect, the same temperature should be employed, and the continuance of the patient in the bath should be extended until nausea supervene. He is then to be removed and placed between blankets in bed, and the flow of sweat encouraged by tepid diluents. To secure the tonic effects, the same temperature may be employed; but the patient should not remain in the bath beyond fifteen minutes; and brisk exercise should be taken immediately afterwards; or, if the patient be too weak to take exercise, friction should be applied to the whole surface of the body. That modification of friction which is called shampooing, an Hindostanee practice, is perhaps the most beneficial.

In the second place, previous to the use of the warm and hot baths, we must attend to the condition of the system. Hot baths are apt to bring on violent headache: thence they ought not to be used by any one predisposed to apoplexy. If warm bathing be necessary for such persons, plethora and every tendency to inflammatory action should be removed by bleeding and purging. The temperature of the bath, also, should be at first under 98°, and gradually increased. But in persons of an opposite diathesis, if a hot bath be necessary, the highest temperature may be employed at first, and the person should remain only a short time in the water, that its stimulant effect alone may be obtained.

The opinion that the warm bath is debilitating, has arisen from the careless and indiscriminate use of the bath, without proper attention to its temperature. According to Markard, a high authority on the subject of baths, the warm bath is tonic when the temperature does not exceed 90°. At Piedmont, during sixteen years, he saw many debilitated individuals restored to strength and health by baths of this temperature: and, during their use, the bathers always remarked that they felt stronger on the day of using the bath. He relates the case of a lady, who for three years was unable to turn in bed: she employed the warm bath every second day; and, in three months, was perfectly restored both to health and strength.

As far as my own experience enables me to judge, I am inclined to extend the temperature to 96° ; under which I have generally observed that baths debilitate rather than invigorate the system. Indeed, Markard himself does not deny that the effects are sometimes debilitating at 90° ; but he ascribes these to the state of the nervous system.

Persons of a sanguine and melancholic temperament agree better with warm bathing than those of opposite temperaments. In the melancholic it is supposed that the warm bath acts by diminishing the rigidity of the muscular fibres, which are supposed to be greater than usual in those of this temperament. It is scarcely requisite for me to say that this statement of the condition of the muscular fibres in these temperaments is erroneous; and, therefore, that any explanation of the benefit derived from the use of the bath, founded upon such premises, cannot be correct. The effect arises from the impression made on the nervous system, and the sympathetic response of the whole frame with the state of the skin.

Children sustain warm bathing better than adults: baths of a moderate temperature are therefore much and successfully employed in their febrile affections. In adult age, women bear warm bathing worse than men; a circumstance depending chiefly on the greater irritability and sensibility of their systems. In the state of pregnancy we are cautioned against ordering the use of the warm bath: but, as little attention is paid to this circumstance in Russia, where the bath is used as a luxury, the necessity of this caution may be doubted.

It was customary with the ancients to anoint the body immediately on coming out of the bath: too rapid evaporation, which is cooling, was thus prevented: and the same custom is still employed by the inhabitants of Asia, within the tropics. It is not less useful in cold climates, for preventing the too rapid abstraction of Caloric from the surface; as this is as hurtful as the checking of perspiration in warmer situations. Indeed, the practice is merely following Nature, who has given to the inhabitants of warm climates a perspirable matter more unctuous than that which she has bestowed on the inhabitants of colder countries. Anointing the body was

anciently a part of the discipline of the bath ; and we find that the Unguentarius was one of the principal officers attached to the public baths of the Greeks and the Romans. Old or long-kept oil was chosen for the purpose of anointing bathers ; and it was rendered saponaceous by a strong admixture, that of an alkali and vinegar. “ *Uctioni*,” says Celsus, “ *vero aptissimum est vetus oleum, vel nitrum, aceto et oleo admixtum.*” When the bather was in a delicate state of habit, the body was anointed, and again immersed in the bath. Indeed, anointing the body was employed under many circumstances by the ancients : thus Celsus says, justly, that it is improper to use the warm bath, in a valetudinary state of the habit, if the temples feel as if bound, and the skin be dry ; “ the bather must,” continues he, “ be gently anointed, and by all means avoid cold, and be abstemious.”

Many accidents occur in Russia from using the warm bath after a full meal ; at which time it impedes digestion, and favours determination to the head. What, then, is the period of the day most proper for the use of the warm bath ? If we refer to the custom of the ancients, whose principal meal was supper, and was taken at sunset, we find that they performed all their violent exercises, and bathed an hour before supper. If it be injurious to use the warm bath with a full stomach, I should say that noon is the best period for employing the warm bath.

When the warm bath is improperly used, it relaxes the frame of body, debilitates generally, causes syncope, hæmorrhages, and dyspepsia ; and, therefore, when any of these occur, the use of the bath should be immediately discontinued.

I now come to the question, how, when, and under what form is the warm bath to be used, for the cure of diseases ? In febrile affections, the warm bath has been employed from time immemorial, both to prevent their accession and to mitigate their symptoms. In intermittent fever, it has been used before the accession of the paroxysm. As far as regards the practice of the ancients, Celsus lays down the most ample directions in the 17th chapter of his second book “ *De Medicina* ;” and setting aside the false theories of the fathers

of our art, many of their ideas upon the subject of warm baths in fever, are excellent. They usually employed the bath during the intermission, rarely during the continuance of the paroxysm. Their cautions upon this point are so correct, that I will translate the words of Celsus: "The warm bath," he says, "may be employed; provided, however, that the præcordia be not hard nor swelled, nor the tongue rough, nor any pain be felt either in the trunk of the body or in the head; and that the fever be not then increasing." If the warm bath be used immediately before the febrile accession, it operates by determining to the surface, and obviating that state of the extreme vessels which always attends the cold stage. In countries where the warm bath is much used, it is supposed to prevent the accession altogether. During the hot stage of fever, the effusion of tepid, or even cold water, is preferable to immersion of the body in warm water; it more rapidly diminishes the heat of the surface, and, consequently, the force of the heart and arterial system. In those cases also, of intermittents, in which there is a great determination to the lungs, the tepid bath, at a temperature of 90°, is most advantageously used.

In typhus, the warm bath is employed to allay morbid irritation, and procure sleep. In those countries where it is much used, it is found to alleviate all the symptoms; and, in a special manner, to counteract the great determination to the head. If we employ it with the view of causing perspiration, it will prove most beneficial at the time that the skin is hot and dry, and the temperature increased. The general warm bath is little employed in this country, in continued fever: the local baths, especially the pediluvium, are more resorted to; and, certainly, by the revulsion which they induce, they arrest that determination to the head which brings on delirium. When this is to be obtained, the temperature should be as high as it can be borne: it should even redden the legs; for, unless this be effected, its counter-irritant influence will be very feeble. In the commencement of fever, if the general bath be used, the temperature should not exceed 98°, and the patient should remain for, at least, half an hour in the bath: in the advanced stages, after debi-

lity has supervened, the heat of the bath should not be under 102° ; but the time of remaining in it should be short, and never should exceed the period when the stimulant effect begins to subside. If the pediluvium only be employed, and the fever have run on for some time, it must be used hot for a very short period, and the patient must not be in the erect position; as this, at any advanced period of the disease, is apt to induce syncope. Dr. Currie employed the warm bath freely in continued fevers, if they were not contagious, especially when they were accompanied with affections of the lungs; and his practice was more successful in these diseases than most men can boast of. This form of bath is also highly useful in hectic, when the heat rises during the paroxysm; and a hot feeling is experienced in the palms of the hands and in the soles of the feet.

In many of those diseases which consist of the inflammation of some particular part, accompanied with general febrile action, the warm bath has been much resorted to. In external inflammations it is often preferable to topical fomentations: easing the pain, lessening the swelling, and allaying irritation. The topical application of warm bathing, particularly in fomentations, is well adapted for these diseases: but, in general, no directions are given regarding their application, which is left altogether to the nurse; consequently they are seldom properly used. In a practical point of view, fomentations are valuable remedies in all cases of inflammation and spasm on the surface; and even in deep-seated inflammation and spasmodic action, such as occurs in colic. The general warm bath, however, is more useful in the passage of gall-stones of a large size, in that of urinary calculi, and in every instance of painful constriction in any internal cavity. Fomentations are highly beneficial in inflammatory affections of the membranes, as in gout and rheumatism; and whenever there is a morbid tension, whether accompanying inflammation or not, from too copious a transmission of blood to a part, and the retention of it, as in piles and many local diseases.

In insanity, the value of warm fomentations was known so early as the time of Cœlius Aurelianus, who ordered warm

fomentations to be applied with sponges to the eyelids, under the supposition that their effects penetrated to the membranes of the brain. It is unnecessary to refute the absurdity of this opinion: but, at the same time, we must agree in the justice of the remark, that, although “we may not be quite satisfied with the anatomical and physiological knowledge of Cœlius, yet we must recollect that he treats very ably of the cure of *Insanity*, and that he doubtless had experienced good effects from this topical application of warm fomentations*.” Much caution, however, is necessary in determining the proper period for using either fomentations or baths in insanity. The warm bath should never be employed in the early stage of mania, at which period, indeed, no temperature exceeding that of the body can be used with impunity. Instead of being refreshed by the bath, of a temperature higher than that of the body, the patient becomes languid; rigors ensue, followed by dry heat of the skin; restlessness, and often wild delirium. It is in the convalescent stage of the disease in which any advantage can be expected from warm bathing; it then excites the secretory organs to healthful action, particularly the liver; it diminishes and dissipates the peculiarly offensive fœtor which maniacs always exhale, and re-establishes the cuticular function. The temperature of the bath, for this purpose, should not exceed 98°, and the patient should not continue in it longer than twenty minutes. If any turgescence of countenance or confusion of ideas supervene, a napkin, wrung out of cold vinegar and water, should be wrapped round the head, and the use of the bath should be suspended.

In a disease of more frequent occurrence, catarrh affecting the Schneiderian membrane, nothing assists so much the removal of the inflammation in the nostrils and frontal sinuses as fomenting the nose and forehead with a large hollow sponge squeezed out of hot water.

Poultices are preferable to fomentations in some cases. They are chiefly used in allaying tension and pain in local inflammation, where the inflammatory action, being confined

* Burrows' Commentaries on Insanity.

to a part, thickens it: by keeping up a proper degree of heat for a certain time, the morbid action terminates in suppuration. Poultices operate on the same principles as fomentations and the warm and vapour baths: their use, therefore, may be greatly extended. Thus, for instance, as perspiration is induced on the part, and much soothing follows their application, I would employ them in internal spasmodic affections, accompanied with pain; namely, colic and peritoneal inflammation. For the latter disease, they may be made with a strong decoction of poppy-heads, instead of plain water. In such cases, also, they should be spread out thin upon cloths, and very frequently repeated.

In every species of Cynanché, or sore throat, warm bathing has been found useful; but more especially in croup, Cynanché *trachealis*, a disease very common to children in some places of this island exposed to north-easterly winds. This disease varies in its symptoms: there is, however, generally spasmodic affection of the muscles of the upper part of the trachea, and a strong inflammatory action in the lining membrane of this air tube. The warm bath is applicable for the mitigation of both these symptoms: it diminishes the febrile action; allays the topical inflammation; and, as the warm vapour is also inhaled during its employment, it takes off the tension of the trachea, and checks the formation of the adventitious membrane, which is the most dangerous part of the disease. In children, indeed, as I have already stated, the warm bath exerts a more decidedly beneficial influence than in adults. When the warm bath produces its salutary effects in children, it is always followed by an easy, tranquil, and profound sleep.

In no disease so particularly as in rheumatism, whether acute or chronic, is the warm bath a remedy of great power. In the acute species, however, the phlogistic diathesis must first be relieved by large doses of calomel, tartar emetic, opium, colchicum, and purgatives; or, if requisite, by bleeding. The bath may be applied either generally or topically, according to the nature of the attack, in the form of vapour, or that of water. The temperature of the general

bath should not exceed 98° ; and the patient should remain in the bath more than twenty-five minutes, or until a feeling of approaching syncope supervene. On rising out of the bath, he should be placed in a bed with blankets only, both because they are bad conductors, and because it is requisite to keep up the perspiration for some hours: when sweating is not excited, the use of the bath increases the severity of the disease. The sweating, when commenced, should be maintained for six or eight hours; for, although sweating be one of the symptoms of rheumatism, it does not prevent the necessity of artificial sweating. In the chronic form of the disease, the bath may be hotter; for, as it is a disease of debility, the patient cannot bear to be severely sweated. After the stimulant effect of the warm bath, as a counterirritant, it may be advantageously employed as a tonic, at a temperature of 96° to 98° , the patient remaining in it for a short time only; and taking brisk exercise immediately after coming out of the bath.

In small pox the warm bath has been used from the earliest periods of recorded facts. In Hungary, Markard relates, that when a person falls sick of small pox, he is immediately put into the bath, then wrapped in warm linen and put to bed, where he is sweated; and this treatment is repeated several times, until pustules appear. While the pustules are out, the use of the bath is discontinued, but whey, or milk and water, are drunk instead of water. Dr. Fisher states, that so successful is this treatment, that, in 1727, in a very fatal epidemic of small pox, no child died in the villages and towns where this treatment was followed. In the writings of De Haen, many successful histories of this treatment are related. In one district in Russia, 116,000 persons were seized with natural small pox in one year: the greater part used the warm vapour bath, and such was its beneficial effects, that not more than twenty-five of the whole number died.

In catarrh, when the cold applied to the surface produces a determination to the lungs and a febrile state of the system, with a dry constricted state of the vessels of the surface,

sweating produces a crisis and obtains relief; and warmth to the whole surface is peculiarly useful and agreeable. In these cases the use of the warm bath is too often neglected; and even the pediluvium, which is more commonly employed, is used in a manner seldom or never efficacious.

In dysentery there is a determination to the intestines, and, whilst the disease proceeds, the surface becomes dry and harsh. One of the principal objects, therefore, of the practitioner is to equalize the circulation and determine to the surface. For this purpose nothing answers better than the warm bath, for promoting the cuticular action, and consequently relieving the intestines: and many proofs of its efficacy from the practice of army physicians—for instance, that of Sir J. Pringle, Sir George Baker, Dr. Rollo, Sir G. Blane, Dr. Dewar, and others—might be brought forward. The temperature of the bath should not exceed 98° ; and the patient should remain in it for a considerable time. It is best adapted to the second stage of the disease, after proper evacuations have been procured and the febrile excitement diminished. Warm bathing is equally well adapted to those complaints of the alimentary canal which arise from irregular or diminished action in the intestines; such as colic and spasmodic obstructions: and not less so for those affections that depend on some directly sedative or paralyzing cause, such as the poison of lead.

In spasmodic and convulsive affections, the warm bath is one of the best remedies we can employ. Tetanus, in particular, has been benefited by its use, in those countries in which the disease is more frequent than in this country. In South Carolina, Dr. Chambers trusted altogether to opium and the warm bath. If the pulse was very frequent, and the heat of surface great, he used it at 96° ; but if the pulse was not much affected, and the temperature of the skin moderate, he then augmented the heat to 102° , and kept his patient in the bath until the pulse became full and soft; and, on taking him out of it, administered the opium every half-hour. Dr. Girdlestone employed the warm bath in the same manner in India. When the disease arises from cold, or alterna-

tions of temperature, this plan will prove successful : but, in traumatic tetanus, dry cupping should be employed along the course of the spine, alternately with the hot bath at 102°.

In dropsy, warm baths, both natural and artificial, have been long employed, and found to aid the removal of the effused fluid : but it must be remarked, that, if the warm bath does not soon cure, it is likely to increase this disease.

In diabetes, the warm bath has been found a useful addition to other means, acting as a counterirritant, in subduing the irritation, both local and general, which is often so conspicuous, and in aiding the influence of narcotics.

Upon the whole, the influence of Caloric as an Excitant, when properly employed, is such as to merit the confidence of the physician*.

c. IODINE.—*Iodinium*. D.

The nature of this elementary substance, and its chemical properties, have been already described (p. 138). It is employed as a general Excitant, both in its uncombined and its combined state.

* *Uncombined Iodine*.

Simple Iodine has been prescribed in the form of pills ; but, as there are many objections to its administration in this form, it is generally given in the form of tincture, which is merely an alcoholic solution of Iodine, in the proportion of two scruples of the Iodine to one ounce of Rectified Spirit. This solution is opaque, of a deep brown colour, exhaling the odour of Iodine, and impressing a very unpleasant taste on the palate. M. Lugol employs an aqueous solution of Iodine, which contains from half a grain to a grain of Iodine in a pint of water, in conjunction with twelve grains of muriate of soda.

The usual dose of the tincture is ten or fifteen minims : but it may be gradually augmented until sixty minims be

* For further information on this subject, the student may consult the work of Markard, which is published in German ; and for those who are unacquainted with that language a valuable abstract of it will be found in Dr. Beddoes' work on Consumption : much useful information is also contained in Saunders' Treatise on Mineral Waters ; Falconer on the Dietetic and Medical Use of Warm Bathing ; and Reid on Warm and Cold Bathing.

taken three times a day. The dose of the aqueous solution is a fluid ounce and a half.

* * *Combined Iodine.*

Iodine combines readily, by simple trituration, with several of the metals and metallic oxides.

Iodide of Mercury.—If metallic Mercury and Iodine be triturated together in equal proportions, these substances combine, and a proto-iodide of mercury is the result: it is of a *yellow* colour, and consists of one prop. of mercury = 200, + 1 of Iodine = 124: equivalent 324. If two parts of Iodine and one of mercury be employed, the product is a biniodide, of an exceedingly *rich red* colour, the equivalent of which necessarily is 448. Both of these preparations may also be readily produced by mixing solutions of the proto-nitrate and the perntrate of mercury with a solution of the hydriodate of potassa. In these cases, the nitric acid of the nitrates employed combines with the potassa of the hydriodate, forming nitrate of potassa; whilst, at the same time, the oxygen of the metallic oxides, uniting with the hydrogen of the hydriodic acid, forms water; and the free Iodine and the metal combining produce the iodides.

These compounds are insoluble in water, unless the water hold in solution a portion of hydriodate of potassa, which aids its solvent power over the Iodine. The proto-iodide, when heated, becomes red; but, on cooling, resumes its yellow colour: on the contrary, the biniodide, when heated, becomes yellow, and the particles acquire a crystalline form; and at 400° Faht. it fuses and sublimes. The dose of these iodides of mercury should not at first exceed a sixth, or a fourth of a grain, which may be given in the form of a pill, night and morning: but sometimes, even in these doses, they cause an uncomfortable sensation of heat at the epigastrium, loss of appetite, and restlessness; under which circumstances their use should be suspended for some days.

For external application, an ointment is prepared with half a drachm of either of the iodides and one ounce of lard.

Iodide of Lead.—This iodide is readily formed by mixing together equal parts of the nitrate of lead dissolved in water

and hydriodate of potassa, also in solution: a yellow precipitate is produced. Dissolved in boiling water, this forms a colourless solution, which, on cooling, deposits crystalline scales of a brilliant golden colour and lustre. This is the iodide of lead: it is composed of 1 prop. of lead = 104, + 1 of Iodine = 124: equivalent 228.

The dose of this preparation for internal use should not exceed a quarter of a grain at first. An ointment is prepared in the proportion of one drachm of the iodide to one ounce of fresh lard.

Hydriodate of Potassa.—Although the iodides which have been described do not hold a place in any of the British Pharmacopœias, yet this preparation is ordered in the work of the Dublin College. The process, however, which is ordered by that learned body is objectionable, on account of the preliminary step of making the hydriodic acid; and, in other respects, it is inferior to the following, proposed by my friend and colleague Dr. Turner*. To a hot solution of pure potassa add as much Iodine as it is capable of dissolving: this forms a brownish-red fluid, consisting of iodate and hydriodate of potassa, with an excess of Iodine. Through this solution transmit a current of sulphuretted hydrogen gas, until the free Iodine and the iodic acid are converted into hydriodic acid, and the fluid becomes quite colourless. Any excess of sulphuretted hydrogen gas is next to be expelled, by heating the fluid; and, after filtering, the free hydriodic acid exactly neutralized by pure potassa.

This solution contains hydriodate of potassa, a salt, consisting of 100.000 parts of hydriodic acid and 37.426 of potassa, and which can exist only in solution. The solution is colourless, slightly acrid, and bitter. When it is evaporated and crystallized, a decomposition takes place, and it is converted into the iodide of potassium, which crystallizes in cubes. This salt, which consists of 100.000 of Iodine and 31.342 of potassa, is fusible and sublimes unchanged at a red heat: it is deliquescent, consequently very soluble, requiring two thirds only of its weight of water, at 60° Fahr. for solution. It is also freely dissolved by alcohol. The hydriodate in

* Turner's Elements of Chemistry, 3d edit. p. 652.

solution has the property of dissolving Iodine—a property which is useful in a practical point of view.

For medicinal purposes, the iodide of potassium, in the proportion of thirty-six grains to an ounce of water, forms a solution of the hydriodate of which from ten to thirty minims are given for a dose three times a day. Ten grains of Iodine may be dissolved in this solution, when a more powerful medicine is required.

Iodine and its preparations operate as powerful Excitants, entering the circulation and exciting in a special manner the capillary system. Its primary action is exerted upon the stomach and intestinal canal—a fact which has been fully ascertained by its effects upon persons who have taken it in overdoses, as well as those observed in dogs who have been poisoned by it. Indeed, from the powerful manner in which it attacks the skin, even when largely diluted, its stimulant influence, when internally administered, might have been prognosticated. When taken into the mouth, in moderate doses in solution, it impresses a slight sensation of heat in the throat, which extends to the stomach and other digestive organs, awaking appetite and promoting the gastric function : but, even in small doses, namely, a quarter of a grain, frequently repeated, it sometimes proves deleterious, in consequence of its absorption and accumulation in the system ; for, like some other remedies, particularly foxglove, it may remain inactive for some time, and then suddenly display its powers with violence. Its absorption is so evident, that its presence can be detected in the blood, in the urine, and in the perspiration. It is supposed that the nervous plexuses and the great sympathetic nerve are particularly acted upon by Iodine : but its chief influence, as an Excitant, is undoubtedly exerted upon the absorbents, which it appears to urge to unusual activity, carrying off by their means not only diseased but healthy glands. During the continued use of Iodine and its preparations, all the organic tissues, particularly the mammæ in women, and the testicles in males, waste : but no gland in the body is exempt from the action of Iodine. M. Lugol has observed a most remarkable discrepancy in the action of Iodine ; namely, that women labouring under scrophula, in-

stead of becoming emaciated, as is common during a course of this medicine, gain flesh ; and Majendie has observed similar effects to occur. When an overdose is taken, the symptoms are heat and a sensation of weight in the epigastrium, pain at the bottom of the sternum, particularly when pressure is made upon that part, cardialgia, great restlessness, burning heat of the skin, excessive thirst, and frequent purging of dark, bilious matter ; the pulse feels weak and tremulous ; palpitations supervene, with frequent syncope and extreme exhaustion. In irritable habits, even when the dose is not so large as to deserve the epithet overdose, it causes a febrile excitement, often accompanied with nausea, vertigo and headache ; and, occasionally, symptoms which resemble those of shaking palsy. When these occur, the use of Iodine as a remedy should be suspended.

As a therapeutical agent, Iodine has proved a successful remedy in bronchocele, and as much so in scrophulous affections* ; but, in the modification of scrophula in which the glands of the mesentery are chiefly involved, little advantage has been derived from it. M. Barbier and some other Continental physicians suggested the propriety of employing Iodine and its preparations in hypertrophy of the heart ; but he candidly acknowledges that his hopes were disappointed. In the Hotel Dieu, where cases of hypertrophy frequently occur, no advantage whatever resulted from the employment of Iodine.

Iodine has been proposed as a remedy in phthisis, under the idea that it might cause the absorption of the tubercles, and remove the indurated state of the pulmonary tissue. It has also been suggested as a remedy to arrest the accession of the paroxysm in gout by M. Gendrin ; but experience has not verified either of these proposals.

In reasoning upon the causes and the nature of ovarian dropsy, I was induced to think that as the tension of the cyst is probably that state which is natural to, and consequently most favourable for, the morbid enlargement of the diseased organ, and that, whilst this remains, the vitality of

* Lugol, *Mem sur l'Emploi de l'Iode dans les Affect. Scroph.* Paris, 1829.

the part would always enable it to resist any effort for its removal by the action of remedial agents on the absorbents, but that, were this tension removed, and the cyst to remain flaccid, it would then be nearly in the state of a foreign body within the abdomen ; and a powerful excitement of the absorbents might be able, if not wholly to remove it, at least so to change the action necessary for its growth as to keep the disease stationary. No Excitant which presented itself appeared so well adapted to fulfil these intentions as Iodine ; I therefore resolved to give it a fair trial, and, immediately after tapping, to throw in as much mercury and Iodine as the stomach would bear ; at the same time, aiding its action by friction over the abdomen with the ointment of the Iodide of lead. Of five cases which have been treated in this manner, three have recovered. In these instances, the tincture, which has been the preparation internally employed, was carried to the extent of sixty minims for a dose, three times a day.

With regard to the value of the different preparations of Iodine, none of them is so powerful in its effects as the Iodide of lead, whether externally or internally employed ; but the simple alcoholic solution of the Iodine itself is preferable to all of them, and also more manageable.

Under whatever form Iodine is administered, its effects must be closely watched, as either the mammæ or the testicles may be carried off, even when the medicine is displaying little apparent influence in other respects. In Rust's Journal there is the case of a female whose breasts, after the medicine had been used for four months, began to sink ; and, in four weeks afterwards, hardly any vestige of them remained, although the goitre, for which the remedy was given, was not in the smallest degree reduced*.

d. MERCURY†. Hydrargyrum. L. E. D.

Mercury was known to the ancients and employed by them

* Magazine für die Gesammte Heilkunde, vol. xxii, p. 291.

† I have not been able to trace the origin of the name Mercury ; but it probably arose at that period when the science of chemistry and the art of healing were both encumbered with the ceremonials of religion and the mysticisms of astrology : thence the metals were placed under the influence of the planets.

in the art of gilding and for other purposes*. It was not until the attempt of the alchemists to render this metal solid produced an examination of its chemical qualities, that the discovery of its medicinal properties was made. In its metallic form it exerts no influence on the animal frame; and it must be combined with sulphur, oxygen, chlorine, cyanogen, iodine, or acids, before it can operate upon the living frame. When combined with these substances, it enters the circulation, exciting powerfully the whole of the glandular system, and increasing, in a remarkable degree, both the secretions and the excretions.

In preparing Quicksilver for medicinal purposes, the first object is to ascertain its purity; for, although it is brought pure into this country, yet it is sometimes, afterwards, adulterated with lead and also with bismuth. To detect these adulterations, a portion of the suspected Mercury must be first shaken with a little distilled water; then digested in some distilled vinegar, which dissolves the oxide of lead formed by the action of the water without acting on the Mercury. If, on shaking this fluid with a solution of sulphuretted hydrogen, it throw down a black precipitate, we may conclude that lead is present in the Mercury. To determine the quantity of the adulteration, a solution of sulphate of soda must be added to the acetate, and the precipitate dried: 100 parts of the dry sulphate indicate 72 per cent. of lead. Mercury readily amalgamates with lead in any proportion; and, when the quantity is not very great, the appearance of the metal is little altered: but a much larger quantity of lead may be held in solution by Mercury without diminishing its fluidity if bismuth be also added to the Mercury. The presence of the bismuth is readily detected by pouring distilled water into the solution of the suspected metal in nitric acid, when, if bismuth be present, a white precipitate falls down.

The first substance which I shall notice as giving activity to Mercury is oxygen. There are two oxides of Mercury:

* Aristotle describes a wooden Venus, which moved by means of Quicksilver, *αργυροσκυτος*, literally *liquid silver*.

the one is a *protoxide*, that is, with a minimum of oxygen, the other a *peroxide*, with a full complement of oxygen.

* *Oxides of Mercury.*

a. Protoxide.—When Mercury is so minutely divided by friction, that the greatest possible surface is exposed to the air, it attracts oxygen and is converted into the *protoxide*. M. Guibourt and some others have denied that Mercury, thus treated, forms a protoxide; and contend that it is a mixture of the deutoxide and very minutely divided Mercury. It is a black powder, without any metallic lustre, insoluble in water, and having a coppery taste; and that it is not merely mechanically divided is evident from its solubility in muriatic acid, which metallic Mercury is not. According to the experiments of Donovan and Seftstrom, this black powder is a compound of

Mercury. . . .	96.16	or	1 prop. = 200
Oxygen. . . .	3.84		1 prop. = 8
	<u>100.00</u>		Equiv. = 208

There is much probability that this statement is true: yet there are some difficulties attending the explanation of the manner in which oxygen unites with Mercury at the temperature of the atmosphere. One proof of its being an oxide is its striking resemblance to the *grey oxide*, which is prepared either by rubbing Calomel in a mortar with pure potassa, washing the product with cold water and drying it spontaneously in a dark place: or, as ordered in the London Pharmacopœia, by boiling one part of Calomel with two hundred and fifty parts of lime-water, constantly stirring until the grey oxide subsides. In this preparation Calomel, which is a chloride of Mercury, is employed; and a muriate of lime and an oxide are formed by the process: we must therefore look for two new principles to complete it—hydrogen, to unite with the chlorine to form the muriatic acid of the muriate of lime, and oxygen to form the grey oxide: we find both of these in the water which is evidently partially decomposed in this process. The same explanation accounts for its formation when, accord-

ing to the Dublin formula, one part of Calomel is rubbed with four parts of hot liquor potassæ. The products are protoxide of mercury and muriate of potassa. If this account of these operations be correct, as it is evident that the grey precipitate formed from the Calomel either by lime-water or by potassa is an oxide, there is reason for concluding that the grey powder procured by trituration, in as much as it resembles that formed from the Calomel, both in its chemical properties and its medicinal influence, is also an oxide.

This protoxide is the base of several of the most useful preparations of Mercury.

Combined with saccharine matter, it forms the *blue pill*, as it is termed: with lard, the *blue or mercurial ointments*; and, with the addition of camphor and ammonia, the *liniment of Mercury* of the London Pharmacopœia; and, with ammoniacum, the *plaster of gum ammoniac and Mercury*. It is this oxide also which forms the active portion of the preparations of Mercury with *magnesia* and with *chalk*. The substances with which the Mercury is triturated in forming these preparations, either by their viscosity or some other quality, facilitate the division of the metal, and consequently its oxidization.

b. Peroxide.—This is Mercury united with a full dose of oxygen. It is effected either by exposing Mercury or its protoxide to the action of heat and air, at a temperature under 600°, or by decomposing the nitrate of Mercury by means of heat. For preparing the first variety, the London College orders a pound of pure Mercury to be put into a tall glass vessel with a narrow mouth and broad bottom, which is to be exposed, open, to a heat of 600° until the Mercury is converted into red scales.

For preparing the second, three pounds of pure Mercury are to be dissolved in a pound and a half of nitric acid, diluted with two pints of distilled water, and the solution evaporated until a white substance remains. This is to be rubbed to powder and exposed in a shallow vessel to a slow fire, gradually raised until red vapours cease to appear.

In the first mode of preparation, the Mercury is slowly

volatilized; and in this state of minute division, at an elevated temperature, it attracts the oxygen of the air circulating within the vessel; and, by degrees, the whole is thus converted into a peroxide. But if the heat be increased above 600°, the oxygen is again expelled, and the oxide reduced to the state of fluid, metallic Mercury.

The Peroxide of Mercury thus prepared, is in deep red or ruby coloured, brilliant scales, inodorous, and impressing an acrid, disagreeable taste on the palate. It is soluble to a small extent in water; is poisonous to animal life, causing violent vomiting and purging when taken into the stomach; and, in small doses, it is capable of quickly producing salivation. This oxide contains, as nearly as possible, double the quantity of oxygen contained in the protoxide; or of

Mercury.....92.6 or 1 prop. = 200

Oxygen..... 7.4.....2 prop. = 16

100.0 Equiv. = 216

When the Nitrate of Mercury is exposed to an increased heat, the greater part of the acid is decomposed, nitric oxide escapes, and a mass of a bright red colour remains. This preparation is generally supposed to be a simple peroxide, arising from the decomposition of the nitric acid; but it generally retains a small portion of the nitrate undecomposed, as the degree of heat requisite to decompose the whole would be sufficient to expel the oxygen and reduce the metal.

Although the chemical components of this oxide are the same as those of the peroxide produced by the action of heat and air, yet it has neither the ruby red colour nor the scaly appearance of the former, when it is prepared in the manner ordered in the Pharmacopœias. M. Gay-Lussac has demonstrated, that the difference observed in the grain and the colour depends on the crystalline state of the nitrate employed. If the salt be well bruised, an orange-yellow oxide, dull, and in powder, is the result; if it be in large dense crystals, the oxide will be of a deep orange colour; and if it be in small crystalline grains, the oxide will have a scaly or crystalline character, and an orange red colour*.

* M. Brugnatelli prepares it by pouring upon one part of pure Nitrate of Mercury, three parts, by weight, of boiling distilled water; a small part only of the

The small portion of the nitrate which the London preparation contains renders it too acrid for internal use; but it is a useful escharotic when applied externally to fungous growths; and forms an excellent stimulating ointment when combined with lard or any bland ointment. Both of these varieties of the peroxide are sometimes adulterated with brick-dust and red oxide of lead. This is easily detected by putting any quantity of the suspected oxide into a thin porcelain saucer, and, after weighing it, submitting it to a strong heat; if there be any residue, its weight will give the quantity of the adulterating substance. If oxide of lead be this substance, it may be at once detected by submitting the suspected peroxide of Mercury to the action of the blow-pipe on a piece of charcoal; if it be pure, the whole will be evaporated; if lead be present, this will remain as a globule in the metallic state.

Such are the Oxides of Mercury; they exert a considerable action on the animal economy, whether taken into the stomach or applied to the surface, or inhaled by the lungs in the form of vapour; in all of which modes they are employed as Excitants. They are taken into the circulation and produce a degree of temporary fever, increasing the action of the heart and arteries, elevating the animal temperature, and augmenting the irritability of the nervous system, manifested by a full quick pulse, heat of skin, perspiration, thirst, and restlessness. After a short time, a taste of copper is perceived in the mouth; the breath acquires a strong foetid odour; the gums swell and become spongy; the tongue enlarges; the teeth loosen; and the saliva is secreted and excreted so abundantly as to run out at the mouth. The continued administration of these oxides, after salivation has increased to a great degree, may augment the fever so as to affect the brain, and even to cause death. When this has taken place, post mortem examinations have detected metallic Mercury deposited in the mesenteric glands, in the salivary

salt dissolves, and the rest is converted into a white concrete powder; five or six parts more of boiling distilled water are then poured on this powder. it instantly acquires a bright scarlet colour, and is red precipitate, requiring only to be washed on the filter and dried in a dark place.

and mammary glands, and in the cancelli of the bones*. During life also the reduced Mercury is exhaled from the surface; as its amalgamation with silver and gold worn in the pockets of those under a mercurial course clearly demonstrates. Now the question is, how has this reduction taken place, and whether is it the oxygen or the entire oxide of the metal that is the active agent? Although the difficulty of determining this point by any direct examination is undoubted, yet we may be conducted to it by collateral evidence. We know, for example, that albumen decomposes corrosive sublimate when taken into the stomach, and reduces it to the state of calomel; it is therefore not improbable, that the albumen of the blood may act in the same manner upon these oxides when they are taken into the circulation in a state of minute division; and, during their reduction, the oxygen which they evolve may produce that state of excitement necessary for the destruction of the action which forms the venereal virus. This hypothesis derives some support from the effects of other oxidizing bodies in syphilitic affections; such, for instance, as the chlorates of gold and of potassa, which cause salivation under certain circumstances. It is, however, certain that the Oxides of Mercury, when properly applied to the skin, or when taken with due caution into the stomach, cure the venereal disease; and manifest their influence on the habit by exciting powerfully the salivary glands and their excretory ducts.

* * *Oxides of Mercury combined with Acids.*

The Oxides of Mercury unite readily with acids. The preparations formed by this union are different according to the nature of the oxide, whether it be a protoxide or a peroxide.

a. Protoxide with Nitric Acid.—The British Pharmacopœias order one preparation in which the protoxide is combined with Nitric Acid, the ointment of Nitrate of Mercury. The salt produced is a perntrate; but it is partially decomposed or reduced to a protonitrate by the fat and oil combined with it. The London College has ordered this ointment to be prepared with six ounces of lard, and only four fluid ounces

* Joan Farnel, cap. 7. Fallopius, cap. 78, &c.

of olive oil ; but when these proportions are adhered to, the nitrate is gradually reduced almost to the simple protoxide ; and the ointment is so brittle as to resemble a plaster, and consequently is unfit for use, unless softened by the addition of oil. When no lard is employed, a golden yellow ointment is the result, which is very long of acquiring an undue consistence ; and it is said, that this consistence is never acquired if a larger proportion of nitric acid be employed. Dr. Duncan has suggested, that the higher oxidizement of the metal may prevent the decomposition of the nitrate ; and he has published the formula of a Mr. Duncan, as fitted to form a most perfect ointment, equal in colour and permanent softness to the empirical preparation known under the name of the Golden Eye Ointment. The difference between this and the officinal preparation, are the larger proportion of acid employed, and the higher temperature applied at the time of the mixture of the mercurial solution with the oily substances*. This ointment is not employed in syphilis except as a topical Excitant in some eruptions in secondary affections of that disease.

b.—With Acetic Acid.—This is the protoxide combined with acetic acid, forming the Acetate of Mercury ordered in the Edinburgh and Dublin Pharmacopœias. The formula of the Edinburgh College, which orders more nitrous acid to be used than is absolutely requisite for the solution of the Mercury, is to be preferred. The proportions are three ounces of Mercury, which are to be dissolved in four ounces and a half of diluted nitrous acid, and the solution added to three ounces of acetate of potassa dissolved in eight pounds of boiling water. In this process, the protonitrate of mercury is first formed, and afterwards decomposed by the acetate of potassa ; the results being nitrate of potassa, with some undecomposed nitrate of mercury held in solution, and a Proto-acetate of Mercury, which, as the solution cools, crystallizes in silky scales, and is easily separated on the filter. It is of importance, in preparing the protonitrate, that a low temperature be employed, as a peroxide might be formed, and a peracetate, instead of the proto-acetate, be

* Edinburgh New Dispensatory, 12th edit. p. 1049.

the result.*. The solution of the acetate of potassa should be tepid when that of the protonitrate of mercury, which should also be warm, is added to it. In washing the crystals on the filter, the water should be slightly acidulated with distilled vinegar, as the protoacetate is extremely susceptible of decomposition. When the water is not acidulated, particularly if it be warm, a black matter, which is protoxide of mercury, precipitates; whilst one portion only of the acetate crystallizes, leaving a deutoacetate and free acid in the mother liquor. For the same reason, it should be dried between folds of blotting-paper, not by heat.

This Acetate of Mercury is in silvery, white, silky, elastic crystals, inodorous, acrid to the taste, and requiring 333 parts of water, at 60° Faht. for their solution. It is insoluble in alcohol. It is decomposed and converted into protoxide of mercury by the alkalies: sulphuric acid also decomposes it, disengaging acetic acid. When it is exposed to the light, it is decomposed: and this occurs also when it is heated; and, as the metal is reduced, vapours of acetic and pyroacetic acid are exhaled.

This salt is capable of curing syphilis; but it is rarely employed. Its dose is from one to four grains. In overdoses, it produces a sensation of burning in the œsophagus and stomach, inflammation of the alimentary canal, vomiting and purging, sometimes of blood. The pulse is quick, full, and hard, the countenance flushed: cramps in the stomach and convulsions succeed, and, if relief be not obtained, the result is fatal.

c. Peroxide with Sulphuric Acid.—The Dublin College orders a persulphate of Mercury to be prepared with six parts of Mercury, six parts of sulphuric acid, and one part of nitric acid. In this process the nitric acid is decomposed, and gives its oxygen to the Mercury, converting it into a peroxide, which unites with the sulphuric acid. This salt is white, and contains an excess of acid; or is a bipersulphate: but, when perfectly neutral, it is not pure white, and is in small prismatic crystals. It deliquesces when it contains an excess of acid;

* The nostrum of *Keyser* was a peracetate.

and, when water is poured on it, by washing off the excess of acid, it is converted into the subsulphate. It consists of 1 prop. Peroxide of Mercury = 216, + 2 prop. Sulphuric acid (40×2) = 80, making the equivalent of the salt 296. It is only used for making the subsulphate and the perchloride of Mercury.

The *sub-sulphate* is formed in two modes: 1. according to the Edinburgh College, by boiling together two parts of Mercury and three of sulphuric acid, and washing off the surplus acid with boiling water: 2. according to the Dublin College, by merely acting upon the bisulphate with hot water. This preparation is too violent in its action to be employed as an internal remedy, and it even requires to be largely sheathed with starch or some bland powder, when it is employed as a topical Excitant, or an Errhine. When it is overdosed, it operates as a powerful irritant, producing violent vomiting, purging, and inflammation of the mucous membrane; but it does not chemically corrode the animal textures.

d. Peroxide, with Muriatic Acid and Ammonia.—The *Hydrargyrum præcipitatum album* of the London Pharmacopœia, the *Hydrargyri submuriatis ammoniatum* of the Dublin, is prepared by precipitating a mixed solution of the perchloride of Mercury and of muriate of ammonia, by means of a solution of subcarbonate of potassa. In this operation, it is supposed that the perchloride suffers a change by the decomposition of a portion of the water, the hydrogen of which unites with the chlorine of the perchloride, and the oxygen with the Mercury thus set free: muriatic acid is formed by the former combination, and, by the latter, peroxide of mercury; whilst the potassa decomposing the muriate of ammonia, the ammonia combines with the peroxide, and shares with it the muriatic acid, thus forming a triple insoluble salt, which is precipitated. It is not improbable that the carbonic acid, in this case, when a subcarbonate is employed, is united with the ammonia, and precipitated with it; but, as Mr. Phillips justly remarks, it is not an essential part of the compound; and the same effect is produced if pure potassa be used instead of the carbonate. When the salt is washed and dried, it is a light, inodorous, insipid, soft, white powder;

perfectly insoluble in water. Its composition is stated to be 1 prop. Peroxide of Mercury = 216, + 1 prop. Muriatic acid = 37, + 1 prop. Ammonia = 17 ; making the equivalent 270. It is sometimes adulterated with white lead or chalk, which are readily detected by exposing some of the preparation to a red heat in a spoon or crucible, when the mercurial preparation is dissipated and the adulteration remains ; this is to be dissolved in nitric acid, and liquor ammoniæ added ; if lead be present, a white precipitate will fall, which sulphuretted hydrogen gas will blacken ; if it be lime, there will be no precipitate.

This preparation is the base of one officinal compound only, the Unguentum Hydrargyri præcipitati albi of the London College, the Unguentum Submuriatis Hydrargyri Ammoniati of the Dublin College. This ointment is a useful stimulant in itch and some other cutaneous affections, when sulphur ointment cannot readily be used on account of its smell. It may be given internally as an alterative ; but it is inferior in every respect to calomel, and thence is very seldom employed.

*** *Mercury with Chlorine.*

Mercury has as powerful affinity for chlorine as for oxygen ; and, by uniting with it, produces salts, which are the most active medicinal agents among the preparations of this metal. If Mercury be poured into a phial containing chlorine gas, and agitated, the fluidity of the metal is instantly destroyed, and the phial becomes coated as if it contained an amalgam of Mercury ; and, by continuing the agitation for a sufficient length of time, a protochloride is formed. When heat is called in to aid the union of the Mercury and the chlorine, the union is more immediate, the Mercury is volatilized, sometimes takes fire, and a bichloride is formed.

a. Perchloride or Bichloride of Mercury.—This is the Hydrargyri Oxymurias of the London College : it is prepared by mixing together 296 parts or one equivalent of the persulphate of Mercury and 120 parts or two equivalents of dried chloride of sodium, and subliming them by means of a strong heat. The theory of this practice is thus explained : the metallic base of the chloride of sodium, the *sodium*, is oxidized at the expense of the peroxide of Mercury contained in the

bipersulphate, and is thus converted into soda; which unites with the sulphuric acid, also set free by the decomposition of the bipersulphate, and forms sulphate of soda: this remains in the bottom of the subliming pot, whilst the chlorine and the Mercury, at the same instant, combine and are *sublimed* in the form of a bichloride. The perfection of the process depends on the preparation of the bipersulphate; for, unless this be complete, a mixed salt, containing both the chloride and perchloride, is the result: the process, therefore, of the Dublin College, into which nitric acid enters and secures the conversion of the Mercury into a peroxide, is to be preferred.

The period when this salt was first made is unknown; it is mentioned in the works of Rhases and Avicenna, who lived in the tenth and eleventh centuries. The processes recommended in the British Pharmacopœias are a modification of the process invented by Kunkel, in 1722. In the large way, the bipersulphate and the sea-salt are ground together with black oxide of manganese, and the mixture, after being left for two or three days and dried with a gentle heat, is sublimed in bolt heads, on a sand bath. It is thus procured in the form of a solid cake.

The simplest and most direct method to form this salt is that recommended by Tromsdorff and Berthollet, to dissolve the red oxide in muriatic acid. The solution is effected without any ebullition or disengagement of gas; and the salt crystallizes spontaneously when the solution is left at rest. This fact supports the opinion that the bichloride, in solution, is a muriate of the peroxide. Perchloride of Mercury is usually in the form of a white semi-transparent mass, consisting of small prismatic crystals; but, when the salt is dissolved in water, and the solution carefully evaporated, it forms in rhomboidal cubes, or quadrangular prisms, with their sides alternately narrower, terminated by dihedral summits. Its taste is extremely acrid, and most disagreeably styptic. Its sp. gr. is 5.200 at 60° Faut. It is soluble in about nineteen parts of cold water, and about twice its weight of boiling water: alcohol, at the ordinary temperature of the atmosphere, dissolves $\frac{3}{4}$ of its weight. It is soluble also in ether, in sulphuric, nitric, and muriatic acids, without altera-

tion—a great practical advantage. Light decomposes the solution of the perchloride in water, and the protochloride is precipitated: but there is some reason for thinking that dissolving the bichloride in water converts it into a perchlorate or permuriate, owing to a partial decomposition of the water, and the consequent formation of muriatic acid and peroxide of Mercury. It is decomposed by the fixed alkalies and lime water; and an orange-coloured oxide of Mercury is precipitated. Solution of arsenic does not decompose it; but the arsenite of potassa, as well as the tartrate of antimony and potassa, and the nitrate of silver, decompose it. The fixed and volatile oils, the resins, all vegetable infusions and decoctions containing gum, sugar, extractive, the bitter principle, and tannin, reduce it to the state of a protochloride: it cannot be long preserved in distilled waters or weak spirits, calomel and muriatic acid being always formed. Acetate and subacetate of lead, sulphuret of potassa, all the hydrosulphurets, and soaps, also decompose it. These substances cannot, therefore, be prescribed in conjunction with Bichloride of Mercury. It is composed of

Chlorine . . .	26.48 or 2 prop.	(36 + 2) =	72
Mercury . . .	73.52 — 1 prop.	— =	200
	100.00	Equivalent	272

The London College orders a solution of the bichloride to be kept ready prepared. But it is a bad preparation; as the light decomposes it, and converts it into the protochloride.

Bichloride of Mercury is a most powerful Excitant. Unless it be given in very minute doses, and in solution, it causes excruciating pain in swallowing, nausea, and vomiting; quickly destroying the vitality of the stomach, and corroding it; exciting inflammation of the lungs, the heart, and the salivary glands, with oppression of the brain and nervous system. Its vapour, even, is highly dangerous to those who breathe it. In small doses, however, it is a valuable Excitant in secondary venereal affections; and in many cutaneous diseases, particularly leprous eruptions.

A question has arisen whether this preparation enters the circulation, or, as Mr. Brodie has maintained, acts

solely through the medium of the nerves. Bichloride of Mercury has not been detected either in the solids or fluids of the body ; but it is possible that it may, nevertheless, pass into the circulation ; for every one conversant with chemical investigations, in reference to the detection of medicinal agents in the blood and secretions, must be aware of the extreme difficulty of detecting them, even when they have been injected into the blood. One fact noticed by Mr. Brodie affords some reason for thinking that it is absorbed ; namely, its effects are not altered by the division of the eighth pair of nerves, which would be the case did the bichloride act solely through the nerves. When it has been taken in an overdose, the best antidote is albumen. and this appears to depend on a circumstance suggested by Dr. Christison, " that compounds, formed by corrosive sublimate with animal and vegetable substances, are either not poisonous, or, at least, very much inferior in activity to corrosive sublimate itself." It is, however, a curious fact, and one which renders albumen a less useful antidote than might be expected, that in excess it does not effectually clothe the irritant influence of the poison ; for the precipitate is redissolved.

As a remedy, Bichloride of Mercury has, occasionally, been a favourite with the leading physicians of different periods. Thus it was highly prized by Boerhaave, Van Sweiten, and their followers ; and on their authority it came to be very generally used in syphilis ; but it often failed in curing the primary symptoms. In the secondary state of the disease, it is useful for allaying the pains ; and a gargle made of it, dissolved in a mixture of bitter almonds, is admirably fitted for healing the ulcers of the tonsils. In cutaneous affections it is an excellent remedy, both taken internally and applied externally, when largely diluted. Mr. Guthrie has lately proposed to employ it in chronic inflammation of the eyes, in the form of an ointment composed of iii or iv scruples of the bichloride, m. xv of the solution of subacetate of lead, and $\frac{3}{4}$ i of cetaceous ointment. As in this case the salt of lead reduces the bichloride to the state of a protochloride, the latter might therefore be used. When administered internally, it acts chiefly on the kidneys ; and, on

account of its acrimony, mucilaginous and demulcent drinks should be given. The general principles upon which it affects the body are nearly the same as those of the oxides.

*b. Protochloride of Mercury, Calomel. * By sublimation.*—If four parts of the Bichloride of Mercury be triturated with three parts of fluid Mercury, a decomposition of the bichloride takes place; a portion of the chlorine passes to the Mercury, and the whole is converted into the protochloride. But although this conversion from the bichloride to the protochloride is so easily effected, yet it is imperfect, and therefore the mixture must be sublimed to complete it. This is the process of the Edinburgh College, which orders a second sublimation. In the London process, four pounds of Mercury, thirty ounces of sulphuric acid, and a pound and a half of salt, are ordered: a persulphate is first formed; and this, being triturated with metallic Mercury, is converted into a protosulphate, which is mixed with the common salt and sublimed. A double exchange takes place, the oxygen of the oxide of Mercury in the protosulphate is attracted by the sodium of the common salt, which is thus converted into soda, and, attaching itself to the sulphuric acid of the protosulphate, forms sulphate of soda, whilst the chlorine of the common salt unites with the freed Mercury and forms the protochloride or Calomel. The subsequent washing with muriate of ammonia, which is ordered in this formula, is of great importance, as it renders any corrosive sublimate that may have sublimed with the Calomel more soluble, and therefore easily separated; but the water must not be at a boiling temperature, as the newly prepared Calomel is apt to be reduced by it and converted into metallic Mercury and bichloride of Mercury. Mr. Hennell, of Apothecaries' Hall, supposes that this takes place even at ordinary temperatures*.

It was formerly thought that many sublimations are necessary to form good Calomel; Lemery orders three sublimations; but, not satisfied with this, it was frequently sublimed seven times, and was then termed *Aquila alba*. In this

* A natural protochloride occurs crystallized in quadrangular prisms terminated by pyramids. It is called *Horn Quicksilver*.

respect, however, the object is defeated by the sublimations; each giving rise to a fresh formation of bichloride: yet, so late as 1760, Professor Alston says, "The oftener it is sublimed, the less it purges, the more easily it enters the lacteals, and so the sooner and more certainly it raises a salivation." This passage is a curious illustration of the great improvement which the last fifty years have produced, both in chemical and in therapeutical knowledge.

The protochloride of Mercury, procured in the large way by sublimation, is usually in the state of a dull white mass; but, when it is carefully sublimed, in small vessels, it forms a cake, on the surface of which crystals appear. Calomel is of a pale ivory colour, which indicates its purity, at least the absence of the perchloride. It is inodorous and nearly insipid. Its specific gravity is 7.2.

* * *By precipitation.*—The Edinburgh and Dublin Colleges order the protochloride to be also prepared by precipitating the protonitrate of Mercury with a solution of sea salt. A double decomposition takes place. The chloride of sodium is formed by solution into muriate of soda, and then into nitrate of soda, by combining with the nitric acid of the protonitrate; whilst the chlorine, attaching itself to the oxide of Mercury, forms the protochloride. There are many objections to this preparation. In the first place, no heat, although ordered in the Pharmacopœias, should be employed in any part of the process, particularly in the formation of the protonitrate, in order to prevent the production of a pernitrate: in the second place, a much larger quantity of water than is ordered should be employed, to prevent the reaction of the hydrochloric and nitric acids and the consequent formation of chlorine, which, by combining with a portion of the protochloride, converts it into the bichloride: in the third place, it is almost impossible to obtain this Calomel free from the protonitrate of Mercury, the acrimony of which causes purging and griping: and, therefore, well-prepared, sublimed Calomel is justly preferred to this precipitated protochloride.

The protochloride of Mercury cannot be regarded as poisonous. It requires 1152 parts of boiling water for its solution. It differs from the bichloride in the following parti-

culars: when rubbed in a mortar with caustic potassa, it is changed into the black protoxide of Mercury, owing to the alkali appropriating the chlorine, changed by the partial decomposition of the water of its solution into hydrochloric acid: the bichloride forms a brick-red precipitate. It is changed by solution in nitric acid, and in the aqueous solution of chlorine, which converts it into the perchloride. Lime-water decomposes the protochloride, in whatever manner prepared, and forms it into the state of the black oxide: and this is an excellent test of its purity; for, if it contain any of the bichloride, which the sublimed Calomel, if not well washed, sometimes contains, an orange-red tint is mixed with the black on the addition of lime-water. The alkalies and their subcarbonates, solution of sulphuretted hydrogen, the hydrosulphurets, solution of soap, and several of the metals, antimony, iron, lead, copper, and their salts, also decompose the protochloride of Mercury. It is partially decomposed by long exposure to light. The composition of this salt is

Chlorine. . . .	15.25	or 1 prop. =	36
Mercury. . . .	84.75	1 prop. =	200
	100.00	Equiv.	236

This is one of the most useful of the mercurial preparations, whether as a remedy in syphilis or for general purposes*. There is, indeed, scarcely any class of diseases for the relief of which it is not more or less employed.

It is curious to observe the extraordinary revolution which has taken place, at various periods, with regard to the doses of this preparation. The ordinary dose, at present, when we are desirous of bringing the system under the mercurial influence, as it is termed, is from one grain to two grains, combined with opium, taken every night, or every morning and evening, or, at the utmost, three times in twenty-four hours, until

* The inventor of Calomel is not known; but the process for preparing it was made public in 1608. It has been known by a variety of names: for example, *Draco mitigatus*, *Sublimatum dulce*, *Aquila alba* and *mitigata*, *Manna metallorum*, *Panchymagogum minerale*, *Panacea Mercurialis*, and several other appellations. The term Calomel, although it is more applicable to a black powder than to one of an ivory colour, yet is a better name, and more effectually prevents this preparation from being confounded with the bichloride, than the appellation *submurias*, adopted by the London and Edinburgh Colleges.

the gums be affected. Schreder states that, in his time, the dose was half a dram : Geoffrey makes it from six grains to thirty : Neuterus gave, at first, fifteen grains ; for the second dose, a scruple ; for the third, half a dram ; and, for the fourth, a scruple ; which he continued until salivation was induced : and Michaelis Albertus informs us that Helwichius gave five scruples for a dose to two patients, and seventy-two grains to a third, which affected the mouth for a fortnight. Even when it was not intended to affect the mouth, scruple and half-dram doses were very common in the seventeenth century ; and, at this day, in India, scruple doses are usually prescribed in the bilious remittents of that climate.

Both these chlorides are extensively employed as alteratives. As I have, hitherto, had no occasion to use the term *Alterative*, and no order of medicines of this name is found in my Table of Classification, it is proper that I explain what is usually meant by the term. Any medicine which is supposed capable, by a slow and continued influence, of altering disordered actions established in the system, or, as they are usually called, chronic, are regarded as Alteratives. Thus, for example, if the biliary secretion be imperfect, or different in quality from healthy bile, and this have been of long continuance, nothing is so likely to change the morbid action of the organ upon which this disordered state of the secretion depends as the continued administration of small doses of mercurial preparations. None of these are so generally employed as the Protochloride and the Bichloride of Mercury.

In chronic rheumatism, chronic laryngitis, mesenteric affections, and some other diseases in which inflammation of a subacute kind has been long continued, lymph is thrown out, and consequent thickening of membranes takes place. In such cases, the administration of small doses of the bichloride, in combination with antimony and opium, have been found highly serviceable when carried to an extent merely sufficient to produce tenderness of the gums, without exciting salivation. Very soon after the mouth is affected the effused lymph is absorbed, and the whole of the discerning system acquires a new and more healthy action. Does

this depend on the Mercury altering the action of the capillaries which has produced the effusion of the lymph? The only reply which can be given is, that the bichloride in these cases, being given in small doses, enters the circulation and stimulates generally the glandular and capillary systems, giving a new action to the whole. Thence, the further effusion of lymph being checked, that which was effused is taken up by the absorbents and thrown out of the system. When, however, the morbid action of the capillaries, which has caused these deposits, has been sufficient to produce a change in the structure of a part, no benefit follows the use of the bichloride, nor indeed of any alterative. The prevention of these structural changes, and the irreparable mischief to which they give rise, is the object for which the bichloride is prescribed; and, unless they are thus anticipated, they become highly dangerous. On the same principles that the bichloride proves beneficial in several cutaneous affections. As an example, we may mention lepra, a disease in which scaly laminæ of cuticle are separated and accumulated on the surface, owing to an altered action of the capillaries in portions of the skin, approaching to subacute inflammation. It is given in doses of from one tenth to one fourth of a grain dissolved in alcohol or in diluted nitric acid. In an highly irritable state, however, of the system, the bichloride, even in the smallest doses, ought not to be given.

When exhibited as an alterative, Calomel, the *protochloride*, operates on nearly the same principles as the bichloride. In all chronic diseases it is advantageously combined with antimonials and opium; but when it is intended merely to improve the hepatic secretion, it acts better when administered alone, at bed time, and a mild aperient is taken in the morning. In the hepatic derangements of warm climates, in particular, Calomel produces the most beneficial effects; for, in general, no sooner does the presence of the Mercurial in the system manifest itself by its influence on the mouth, than the secretion of the bile assumes its proper and healthy aspect. It is, however, necessary to be aware that no Mercurial should be administered in acute inflammatory affections of the liver, until depletion has brought down the pulse; but

when this has been effected, it should then be given in such large doses as will rapidly produce ptyalism. When abscess occurs, the protochloride is injurious.

In the fevers of warm climates, Calomel is given in doses of from eight to ten grains every three hours; but even in such doses it does not act powerfully on the salivary glands; nor is this required, as salivation would lower the system too much, and produce a very dangerous state of exhaustion. In the fevers of this country, a mild action on the mouth, from Mercurial remedies, is generally the first indication of the safety of the patient. It proves most useful when the tongue is much coated, the mouth clammy, and the stools dark and offensive. In remittent fevers it is less to be recommended than in either intermittents or continued fevers: indeed, we have rarely seen it supersede the febrile action in remittents. In hectic it proves injurious.

During the administration of Calomel in hepatic derangements, it frequently happens that the secretions apparently become worse instead of better; the stools looking green, slimy, and either have no odour or are extremely foetid. I have indeed more than once seen Calomel produce clay-coloured stools. It would be in vain to look for healthy evacuations, as prognosticating an improved state of the secretions, in such cases; but this is no proof that a beneficial effect has not been produced by the remedy. It is, however, necessary to intermit its use for a few days, in order to ascertain the real state of the alvine ejections, which shew their natural character as soon as the intestines cease to be irritated, by the primary action of the remedy on the biliary and pancreatic ducts, bringing large quantities of badly concocted bile and pancreatic juice into the intestines. In this state of the habit much advantage may also be derived from diminishing the dose of the Calomel. It, nevertheless, often happens that small doses of Calomel cannot be retained on the stomach when this viscus is in an irritable state; and that in this case large doses act as a sedative. My own experience has afforded me numerous illustrations of this remark; and my observations have been confirmed by a high authority on this subject, Mr. Annesley, as far

as regards the employment of Calomel in India. "In large doses," says Mr. Annesley, "Calomel combines with and renders fluid and detaches the viscid mucous secretions attached to the alimentary canal: it diminishes the vascular state of the stomach when this is in excess, and increases the capillary circulation in the mucous coat of the larger intestines. Thence it is useful, in large doses, in increased vascular action of the intestinal canal, indicated by the state of the tongue and the irritability of the stomach, such as occurs in fever, hepatitis, dysentery, and peritoneal inflammation after a full bleeding*." In the dysentery of the Carnatic, when much irritability of the stomach exists, it is given in doses of a scruple every night; and this is followed by an oleaginous purgative in the morning as long as the pain continues. It acts most beneficially when the secretions are improved without any specific action being induced on the salivary glands; and, therefore, the purgative in the morning is requisite on this account.

No remedy proves so decidedly useful as Calomel in combination with opium, administered after bleeding and purging, in croup. In the modified form of this disease, also, when it assumes somewhat of the aspect of Angina maligna, the pharynx and fauces being covered with grey, sloughy ulcers, Calomel, in full doses, is the only resource to be depended upon. In pneumonia, Dr. Hamilton, of Lynn Regis, a practitioner of great judgment and experience, after bleeding and purging, gave Calomel, in doses of from gr. i to gr. v, combined with gr. $\frac{1}{4}$ to gr. i of opium, every six or eight hours, until the mouth became touched; diluting freely with bland liquids in the intervals: and in few hands have inflammations of the lungs been more successfully treated. Dr. J. Clark, in his work on the Diseases of Long Voyages, recommends this form of Mercury strongly in the intermittents of warm climates, when there is great irritability of the stomach, attended with vomiting of bile: and this practice is supported by the authority of Mr. Annesley, who recommends a scruple of Calomel and two grains of opium in such cases. He combines the Calomel with the opium; and in this form it increases the tonic power of the bark, when the use of that

* Annesley's Sketches of Diseases of India.

medicine is indicated. In the intermittents of our own climate, I have seen the bark and also the sulphate of quinia given, without any benefit for several successive days; and, yet, immediately afterwards, they cured the disease when Calomel and opium were administered at bed-time. Calomel is still most useful when the ague is complicated with hepatic affections. It is given in doses of $\mathfrak{z}$ i for several successive nights, each dose being followed by a purgative in the morning, as a prelude to the use of the cinchona bark and its salts, in the intermittents of India; and continued, *pari passu*, with the bark, in small doses, until the tongue becomes clean*.

Such are the few remarks which I think necessary to offer respecting the employment of Calomel and the Bichloride of Mercury, independent of their influence in the cure of venereal affections.

* * * * *Mercury with Sulphur.*

We find that sulphur is combined with Mercury in two ways—with and without the aid of caloric. In the first, simple trituration of equal parts of mercury and sulphur is continued until all the metallic globules disappear and a uniform black powder is produced, which is insipid and inodorous. This is the *Black Sulphuret of Mercury*, the *Hydrargyri Sulphuretum Nigrum* of the British Pharmacopœias. The rationale of the operation is not well understood. It was maintained by Fourcroy that the metal is imperfectly oxidized; but this opinion was refuted by Proust, by a set of admirably conceived and satisfactory experiments. It is now a well-established fact, that a direct combination between a metallic oxide and sulphur is a rare occurrence. It is probable that the Mercury unites with its full complement of sulphur, and is formed into a Bisulphuret of Mercury, which, in the entire preparation, is united with some uncombined sulphur. This opinion of its composition is confirmed by the fact, that, by boiling the Black Sulphuret of Mercury in a solution of pure potassa, the excess of sulphur is converted into sulphuret of potassa, and thus removed from the Sulphuret of Mercury, which remains in the form of a black powder, insoluble in nitric acid; and, when exposed to a red heat, it assumes all the characters of

* Annesley's Sketches of Diseases in India, p. 491.

the red sulphuret, or cinnabar. Now, as cinnabar requires for its formation two proportionals of sulphur and one of mercury, the conversion of the black powder, remaining after the action of the potassa, into cinnabar, when exposed to a red heat, authorizes the conclusion that the mercury in this preparation exists also as a bisulphuret. If this opinion be correct, the Black Sulphuret of Mercury is a compound of

Bisulphuret of Mercury . 58 or 1 prop. = 232

Sulphur 42 ... 1 prop. = 16

$\frac{100}{\text{Equiv. } 248}$

This is the opinion of Mr. Brande; and it is much more probable than that of Mr. Phillips, who regards it as a mixture of protosulphuret of mercury and sulphur. Yet he gives as its equivalent 216,—or 1 prop. of Mercury = 200

1 prop. of Sulphur = 16
 $\frac{216}{\text{Equiv.}}$

When heated in an open vessel, it emits sulphurous acid gas, becomes of a deep violet hue, and afterwards sublimes of a brilliant red colour.

This is a very uncertain preparation; and, even when well prepared, it exerts merely an alterative effect on the habit. It is chiefly used to reduce scrophulous swellings; and sometimes in diseases of the skin, and for destroying ascarides.

b. Bisulphuret.—The second preparation of sulphur with Mercury in which heat is employed is the Red Sulphuret, Hydrargyrium Sulphuretum Rubrum of the London College. It is prepared by bringing the Mercury into contact with the sulphur in a melted state, and afterwards rubbing the compound into powder, and subliming. It is more simply prepared by subliming the black sulphuret prepared by trituration.

This preparation may be regarded as a bisulphuret, in which the combination of the sulphur and mercury is more complete than in the black sulphuret. It is in the form of bright red crystalline cakes; is inodorous and insipid, insoluble in water. It is soluble in a mixture of nitric and muriatic acid, which decomposes it and separates the sulphur. It is decomposed in a red heat; the sulphur being converted into sulphurous acid and flying off, and the Mercury evapo-

rating in fumes : and, also, by lime, the alkalies, and several of the metals. It consists of

Mercury	. 86.2 or 1 prop.	= 200
Sulphur	. 13.8 — 2 prop. (16×2)	= 32
	<u>100.0</u>	<u>= 232</u>

As a remedial agent in venereal affections, it has been used in the form of fumigation ; but it is inferior to the grey oxide for this purpose, and being altogether a very inert and unnecessary preparation, it is now rarely employed, except in some empirical nostrums, in which Dr. Paris assures us that it forms the chief ingredient.

* * * * * *Mercury with Cyanogen.*

Mercury in the state of a peroxide combines with CYANOGEN, a compound substance consisting of carbon and nitrogen in intimate union.

Cyanogen is a transparent, colourless, gaseous body, with a very peculiar penetrating odour. It is distinguished from other gases by burning with a violet-coloured flame. Its specific gravity is 1.804 : 100 cubic inches weigh 55.06 grains : and it assumes the liquid form under a pressure of four atmospheres, at 45°. It is absorbed readily by water, and the solution reddens tincture of litmus, which is again restored to its blue colour by the addition of carbonic acid. Cyanogen is soluble in water : the solution, which has a pungent taste, gradually acquires a yellow colour and then a brown ; carbonate and hydrocyanate of ammonia are formed, and may be separated by distillation with the water, whilst crystals of cyanic acid constitute the residue. This gas was discovered by Gay-Lussac in 1815 ; and his experiments demonstrate that it is a carburet of nitrogen, consisting of carbon 0.8320, + nitrogen 0.9691 = 1.8011 ; or 2 prop. of carbon (2 × 6) = 12, + 1 prop. of nitrogen = 14 ; making its equivalent 26. It combines readily with peroxide of Mercury.

Cyanuret or Bicyanide of Mercury is formed by boiling eleven parts of peroxide of Mercury with eight of hydrocyanate of iron (Prussian blue) : a double decomposition takes place ; the oxygen of the peroxide unites with the hydrogen of the hydrocyanic acid in the prussiate of iron, forming water ;

two equivalents of the cyanogen, set free, unite with the Mercury and produce the cyanuret, which remains in solution; while one equivalent of cyanide of iron and two of peroxide of iron are precipitated.

Cyanuret of Mercury, perfectly neutral, is colourless, inodorous, with a styptic, disagreeable taste. Its crystals are long, quadrangular prisms, having a specific gravity 2.7612; soluble in water, but more so in hot than in cold water: boiling water deposits again the salt on cooling. The solution is decomposed by sulphuretted hydrogen gas; protosulphuret of Mercury is precipitated, and hydrocyanic acid remains in the solution. The salt is decomposed by heat; the Mercury is sublimed in the vessel, and the cyanogen escapes in the gaseous state.

Cyanuret of Mercury is composed of 7.91 parts of Mercury + 20.009 of cyanogen; or 1 prop. Mercury = 200, + 2 prop. cyanogen (26×2) = 52; making the equivalents 252.

This preparation, now ordered by the Dublin College, is employed on the Continent as a remedy in syphilis, and in suppression of urine*. From gr. xii to gr. xxiv are dissolved in two pints of distilled water; and from one spoonful to four spoonfuls, in a glassful of mucilage of gum, are given twice a day. It is also prescribed in pills containing from one eighth to one sixth of a grain. But it requires to be administered with great caution, as it operates as a virulent poison when given in large doses, producing effects closely resembling those caused by corrosive sublimate. When an accident of this kind occurs, after emptying the stomach, a solution of sulphuretted hydrogen should be administered, and the habit treated as if under the influence of an inflammatory disease.

* * * * * *Mercury with Iodine.*

The combinations of Mercury with Iodine have been already mentioned; and it is only necessary to mention here that they may be formed by triturating the Mercury and iodine together and afterwards subliming it in a tube. An excess

* Archives Générales de Médecine, vol. ix.

of Mercury is necessary, to prevent any uncombined iodine from existing in the preparations.

Such are the Mercurial Excitants. I have purposely refrained from entering very minutely into the method of preparing them, and offering many critical remarks on the formulæ; my object being rather to explain the theory of their composition, and their therapeutical properties, than to criticize pharmaceutical compositions of the Pharmacopœias. In explaining the remedial effects of these Mercurials, I intend to confine myself, at present, chiefly to the consideration of their influence in curing syphilis.

Mercury, in whatever form it is administered, and in whatever manner it is introduced into the living body, acts as an Excitant; a febrile state of the body is induced, evidenced both by the condition of the pulse and that of the nervous system; and, also, by an augmented secretion and excretion of the saliva. It is this febrile excitement, overcoming or destroying the morbid action begun and maintained in the frame by the introduction of the syphilitic or venereal poison into it, which cures syphilis. The action on the salivary glands is only a symptom of this general excitement, induced by Mercurials, and not in itself essential to their curative power: it may not be produced by the administration of Mercurials, and yet syphilis may be cured by them.

In this case the Mercurials are nevertheless taken into the circulation. "I remember," says Mr. Berry, in detailing a case published in the Medical Gazette of March, 1831, "a young man who took Mercury for a considerable time without producing ptyalism; but, at the same time, a silver watch and money, which he had in his pocket, had become blue."

Mercury, like every other stimulus long continued, debilitates; and, consequently, emaciation is the constant attendant of a mercurial course. In producing their effects, mercurial preparations, whether *oxides*, *chlorides*, *cyanides*, *iodides*, or any other, are decomposed, and the Mercury, in a metallic form, is either thrown out of the body by the skin and lungs, or is deposited in the glands and the bones. The first of these facts is proved by the whitening of gold worn in the pocket of a

a person under the influence of Mercury ; the second fact has been demonstrated by post mortem examinations, as already noticed.

Many curious stories are told relative to the manner in which Mercury passes out of the habit. Thus Fallopius, in his *Treatise de Morbo Gallico*, and some other old authors, relate, that gold held in the mouths of persons salivated with Mercury has been amalgamated, and the Mercury afterwards expelled from these amalgams by heat. Fourcroy mentions a story of a gilder, who was attacked with an eruption of small boils, in each of which a globule of quicksilver was found : M. Tourda and Dr. Cantu of Turin, have published accounts of its being found in the urine ; and Zeller declares that he has found it both in the urine and in the bile. These statements, however, are at variance with the experiments of M. Devergie, who could find no Mercury in the blood drawn from a man who had taken 171 mercurial pills, or that of another who had taken 184 : neither could he detect it in the saliva of many men under courses of Mercury : nor in ten litres, nearly twenty-two wine pints, of urine, in a ward of men under mercurial friction. There is less doubt with respect to metallic Mercury being found in the bones. Hufeland states, in his *Journal*, that there is a pelvis of a young woman who died of syphilis, preserved in the Lubben Cabinet of Midwifery, which is infiltrated with Mercury. The proof of its exhalation by the skin is sufficient.

The preparations of Mercury may be introduced into the system both internally and by external application to the cuticular surface : in both cases it is conveyed into the circulation ; and, in a short time, produces the peculiar symptoms which have been described. When externally applied, the mercurial, in the form of ointment, is rubbed upon the parts of the body where the skin is thin : as, for example, the insides of the thighs and the arms ; or it is inhaled in the vapour of fumigation ; or the skin is bathed with it in the form of lotions : for internal administration, Mercurials may be prescribed either in substance or in solution.

It was formerly the custom, previous to the administration

of mercurials, to reduce the system by bleeding, purging, and low diet. Perhaps this was carried too far: but, for many years, the state of the habit was too little attended to previous to the commencement of a Mercurial course; and, if any benefit have arisen from some late endeavours to cure venereal affections without the use of mercurials, it is from the re-introduction of the former preparatory measures, within certain limits. Under any circumstances, it is necessary, during a mercurial course, that the patient be restricted from exposing himself to all weathers, and pursuing his usual occupations and pleasures. On the contrary, he must maintain the temperature of the surface uniform by warm clothing; both on account of aiding the action of the remedy on the glandular system, and enabling the Mercury to pass off freely by the surface. If the stomach and intestines be in an irritable condition, Mercurials in small doses are likely to increase this state; and, therefore, opium is to be combined with the mercurial preparations employed; warm bathing resorted to, and additional and warmer clothing. If much sweating supervene, the patient must be cautiously exposed to a cooler air; the clothing lightened; bark and acids exhibited; and the perspirations moderately checked as soon as they come on: and this is the more necessary to be attended to if salivation is not to be produced.

Friction with the mercurial ointment is more frequently employed than any other mode of exhibiting mercurial remedies in syphilis. It is usual to begin by rubbing 3ss of the ointment on the inside of the thighs. This friction should be performed before a fire, and with some degree of force; as the wearing down of the cuticle favours the absorption of the oxide. This operation should always be performed by the patient himself. The merely spreading the ointment over the surface, as is frequently done by the slovenly and indolent, disappoints the expectations of both the patient and the practitioner. The quantity of the ointment should be gradually increased; and its use continued until a coppery taste is felt in the mouth; the breath becomes foetid, and the gums tender: after which, the friction may be employed less frequently, if these symptoms increase. On the contrary, if

they do not appear in eight or ten days after the commencement of the use of the ointment, the quantity must be augmented.

A slight degree of salivation is proper, in order to satisfy the practitioner that the Mercury is producing its full action on the habit ; but this effect must be closely watched, for, in some persons, very small quantities of any mercurial will produce violent salivation ; thence the necessity of enquiring into the effects of previous mercurial courses on persons whom we are about to bring under its influence, and also to ascertain in what climates it has been administered ; for nothing produces a greater diversity in the susceptibility of the same individual to what may be termed the mercurial impression than the climate in which the remedy is administered. Under all circumstances, beyond a certain degree, salivation must be checked.

Many methods have been devised to check salivation ; and many preparations of Mercury projected with the view of obtaining its full effect on the habit without inducing salivation. Thus, Plenck, an excellent physician and a well-known medical author, supposed that he could effect this by oxidizing the Mercury by trituration in water with gum Arabic : it has also been proposed, for this purpose, to exhibit the Mercury in the form of an amalgam with tin ; but, if Mercury acts upon the habit, no form of preparation that has any activity can produce its full effect without exciting some degree of salivation. It is not the salivation, therefore, that is the evil, but the excess of it. The symptoms that indicate its excess are swelling of the tongue and the insides of the cheeks to a great degree, swelling and ulcerations of the tonsils, the formation of sloughing ulcers, fever, great restlessness, and a copious discharge of saliva. The means which have been suggested to check profuse salivation are various. Some of them, however, are not to be recommended, and frequently fail in fulfilling the intention of the physician. Let us examine them.

Sulphur, it is well known, diminishes the activity of antimonial and arsenical salts ; and it has been prescribed upon the same principle to check salivation ; but the experience of

those who have had the best opportunities of judging have not satisfied them that it possesses any efficacy in diminishing mercurial action. It is true that the sulphurets of Mercury do not excite salivation so readily as the other preparations of Mercury ; but it must be also kept in view that they do not induce that state of excitement necessary for curing syphilis. If preparations of sulphur have, at any time, proved beneficial in checking salivation, the effect is to be referred to their acting either as sudorifics or as purgatives.

Nitre, camphor, cinchona bark, preparations of iron, and many other medicines, have also been employed, to little purpose, in profuse salivation ; and indeed none of them, with the exception of cinchona bark and the salts of iron, if the debility be great, deserve the confidence of the physician. As a mere local application, alcohol or brandy and water, used as a gargle, is as efficacious as any thing ; and nothing tends so much to render the patient comfortable as a mixture of the chloro-sodiac solutions of Labarraque in water, in the proportion of one part of the solution to four of water ; or a weak solution of the sulphate of copper in water.

Blisters may also prove beneficial when applied as counter-irritants to moderate the inflammatory state of the mouth and the salivary glands ; but I have had no experience of their effects to enable me to judge of their efficacy. If blisters be employed, they should be applied to the neck, but not immediately over the affected glands.

A more effectual method of checking salivation is the administration of purgatives and opium : the former produces its beneficial effect by inducing a greater action in the intestinal system of glands, and thereby lessening the determination of blood to the salivary organs ; the latter by diminishing the general irritability of the habit. But the most decided method of checking profuse salivation is the free exposure of the patient to a cool dry air. Mr. John Pearson, who first recommended this method of managing salivation, remarks that he was induced to try it from observing its excellent effects in that often fatal mercurial Erethismus which sometimes occurs when mercurials appear to act as poisons upon

the system. "The good effects of the practice," he adds, "justified my expectations; for I observed that the breathing of a cool dry air was no less beneficial than pleasant to a person affected with ulcerated cheeks and gums; the animal spirits were likewise recruited; and the health so much improved, in the course of a week or ten days, that the patient was generally capable of returning to the use of his medicine again*." I have said the animal spirits are recruited: we may add, the abstraction also of the mind from the state of the salivary glands, by taking the patient from the monotony of his chamber and carrying him into the country, greatly aids the checking of profuse salivation, which is often kept up by excessive attention to the discharge, and from the constant attempts to eject it. The flow of saliva into the mouth is augmented, indeed, even in a state of health, by thinking of it; and this appears to depend on an increased determination of blood to the part, in the same manner as in blushing; in which the flow of blood is the result of a mental stimulus on a particular set of nerves. If this explanation of the obstinacy of profuse salivation in some cases be correct, it should be an object, in attempting to check it, to divert, as much as possible, the attention of the patient from his own feelings. In checking salivation, however, by free exposure to cool dry air, much caution is necessary that the action of the salivary glands be not too suddenly checked. "I have seen," says Mr. Pearson, "not only pains, but even general convulsions, produced from the same cause." This is, in fact, merely an example of that *metastasis* or translation of disease which occurs when some inflammations are suddenly checked. When it occurs, the patient should be put into the hot bath, and the Mercurials again introduced as quickly as possible into the habit, until the salivation be restored in a moderate degree.

In long-continued mercurial courses, the high state of morbid irritation is sometimes followed by an exhaustion which, too frequently, proceeds rapidly to a fatal termination. On the first appearance of such a state, the use of the medicine

* Pearson's Observations on the Effects of various Articles of the Materia Medica in Lues Venerea, p. 135.

must be instantly suspended, and the patients exposed freely to a cool atmosphere, with a liberal allowance of mild but nutritive diet. I have been in the habit of ordering the sulphate of quinia, combined with sulphuric acid, in small doses, from one to two grains every second hour, for two or three days; and have always found it followed by the best effects. But, as it is always better to prevent evil, Mercurials should be introduced into the system gradually, and in the weakest form at first. Thus, if the preparation selected be the ointment, the weaker form of this medicine should be first employed, until three or four drams are used in each rubbing: the stronger is then to be resorted to in an equivalent proportion: and if, after some time, the habit appear to resist the influence of the remedy in this form, it must be internally administered: or, if no effect be still produced, Calomel may be rubbed on the inside of the gums and the cheeks, and fumigations of the grey precipitated oxide employed. Some physicians have recommended, in such cases, that the subsulphate, a preparation scarcely ever used except as an errhine, should be given in doses of four or five grains to excite vomiting. This practice is founded on correct physiological principles; for vomiting greatly favours that state of habit which is the result of the absorption of mercurial preparations into the circulating mass.

During a mercurial course, although the efficacy of the remedy depends on its exciting power, yet the excitement should be moderate. The salivation should never exceed, at the utmost, two pints in twenty-four hours; the temperature of the air in which the patient lives should not be above 75°, nor below 65° of Faht.; and the cutaneous function regularly cherished by flannel worn next the skin. The diet should be confined to milk, broths plainly cooked, mild animal food, and water or whey for drink.

No precise rules can be laid down for the duration of a mercurial course. When it is terminated, there is no necessity for immediate warm bathing and purging, as was formerly the practice; but the patient should go into the country, live much in the open air, and gradually return to a full diet, with the moderate use of wine. After a certain degree

of tone of the habit is restored, the tepid bath may be advantageously employed ; but it should be used in the forenoon, and brisk exercise taken immediately afterwards.

Persons of a peculiarly nervous or irritable state of habit are liable, when strongly agitated by mental impressions, or exposed to sudden alternations of heat and cold, to be attacked with a vesicular eruption of that kind which is termed Eczema, and which, in this state of habit, has often terminated in death. This affection was first noticed by Mr. Benjamin Bell, and afterwards investigated by Mr. Alley, of Dublin, Dr. Moriarty, Dr. Spens, Dr. Mc Mullin, Dr. Sylvester, Dr. Willan, Dr. Duncan, jun. Dr. Kellie, Mr. Pearson, and several others. It is generally preceded by fever, dry cough, and tightness across the præcordia, which do not abate when the eruption appears, which is, at first, a diffused redness, with crowded, extremely minute vesications ; and the hairs, easily detaching themselves, fall from every part of the body. The eyes and palpebræ are completely denuded, and the eyes themselves assume an inflamed aspect that gives the countenance a disagreeable expression. The head swells, and sometimes so much as to shut the eyes altogether. The eruption extends itself from the scrotum and thighs over the whole body ; and the skin, in various places, comes off in large flakes. When it proves fatal, the event is to be ascribed to the extreme exhaustion that accompanies the attack. No causes have been assigned for this eruption : it is not confined to any particular season nor kind of weather : it attacks adults rather than the young : but no period of life is exempt from it. My own experience is at variance with the opinion that all temperaments are equally liable to this disease : on the contrary, the sanguine appear peculiarly susceptible to its attack. Sudden exposure to cold is not, of itself, sufficient to produce the disease ; and I feel that I am authorized in referring it to that peculiar state of the habit termed the *hysterical**.

Four points are necessary to be attended to in the treatment of syphilitic diseases by Mercurials.

* A case, highly illustrative of this opinion, is detailed in Thomson's Atlas of Delineations of Cutaneous Disease, art. Eczema.

1. The state of the venereal disease in which Mercurials are required.

2. The intention with which Mercurials are prescribed in syphilis.

3. How to select the preparations best adapted for each case.

4. The rationale of the operation of Mercurials and of some peculiar effects of Mercury in syphilis.

Although syphilis is a disease which is produced by *contagion*, yet we are utterly ignorant of its origin. The silence of the fathers of medicine, of the ancient historians, and the poets, on the subject, affords ample reason for supposing that it was unknown to the Greeks and the Romans; nor is there any reference to it, either in the traditions or the history of European nations, before the middle of the fifteenth century. It appeared first in the kingdom of Naples, in the year 1494, when invaded by Charles the Eighth of France; on which account the Neapolitans, who asserted that the French had introduced it amongst them, called it the French pox, or *Morbus Gallicus*, whilst the French denominated it the Neapolitan malady. The most generally believed opinion is that it was brought from America by the sailors under Christopher Columbus; at all events, its appearance was almost simultaneous with the return of that distinguished navigator; and it soon spread with an unprecedented rapidity through every kingdom of the old world. Whatever may have been its origin, it is always communicated by contact, or the direct application of the contagious virus from the body of an infected individual to that of a healthy person. It is a disease peculiar to the human species; at least we have no knowledge that it has ever occurred among the lower animals: and this is the more remarkable from the domestication of some animals, and the many opportunities to which they are liable, in the event of wounds or sores on their bodies, of receiving the virus upon these denuded surfaces, and thereby of being inoculated with the disease, if they were susceptible of it.

Although syphilis is contagious, yet the virus must not only come in contact with the body of the person, but it must

be conveyed beyond the sphere of the cuticle before the disease can be communicated: that is, the virus must be applied either to an abraded surface, or to one in which there is some lesion capable of admitting inoculation to be effected. When the disease is propagated by sexual intercourse, the organs of generation are first affected; when it passes from an infant born with the disease to the nurse, the breast is first affected; when from a nurse to an infant, the lips and mouth of the child first suffer.

When the virus is simply applied to a secreting surface, an erythematic or superficial inflammation supervenes, and the natural secretion of the part is augmented. This is a very common circumstance in the urethra, and the disease produced by it is termed gonorrhœa. The identity of the virus of this disease with that of real syphilis has, it is true, been doubted; but the probability of their identity is very strong.

The first effect of the application of the syphilitic virus to the healthy body is local; but it is gradually conveyed into the system. It would be out of place here to trace the symptoms which follow from this introduction of the virus into the circulation: it is only when it occurs that the administration of Mercurials, so as to affect the whole system, is requisite; and it is, therefore, this state of the syphilitic disease that demands our attention. Let us therefore now enquire into the intentions which are to be answered in exhibiting Mercury in this stage of the disease. These may be regarded as two:—1. To excite a moderate salivation. 2. To raise the mercurial irritation in the system to such a degree that we shall be satisfied that the body is charged with the remedy.

As I have already stated, salivation was long regarded as absolutely necessary for the cure of every case of syphilis, on the supposition that the virus of the disease is evacuated by the salivary glands; and consequently that syphilis can only be cured by the augmentation of the salivary excretion to a very considerable degree. This is nevertheless an untenable position; and the objections to salivation being carried to any great extent are manifold. In the first place, the quantity of a Mercurial necessary to cause a severe salivation excites a degree of fever quite unnecessary; and the irritability and

debility which result from it cannot be borne with safety by many habits; as, for example, by the young below fifteen years of age, the old and naturally debilitated, and those prone to the formation of tubercles, the foundation of consumption in the lungs. Salivation, also, in defiance of every means employed to check it, often advances so rapidly that the face swells, the tongue enlarges, and the fauces are so much inflamed and swelled that there is danger of suffocation. Violent diarrhœas often occur from the diseased saliva being swallowed, or by the Mercury stimulating the pancreas. Besides these formidable objections to profuse salivation, epileptic fits have been, not unfrequently, occasioned by it. The causes of these are not well understood; they have been supposed to depend on the Mercury overstimulating the brain, or on a portion of it being reduced and lodged in the cavities of the brain. I will not presume to decide upon these hypotheses: any cases resembling epilepsy, which I have seen, arising from the stimulus of Mercury, have occurred in highly irritable habits; and I am disposed to think that it is the increase of this state by the mercurial rendering the individual susceptible of impressions, which would not otherwise affect the nervous system, that bring on those fits which have been called epileptic. The last objection which may be urged against salivation is, that the ulcerations of the mouth, the caries and the loosening of the teeth, and the rheumatic affections excited by it, remain for a long time after it has ceased; and the whole constitution appears to have received a shock from which it never recovers.

On these accounts, *profuse* salivation is now seldom induced, as it can be dispensed with, and yet the disease be cured. When the disease has been of long standing and is very inveterate, salivation is requisite to mark the full saturation of the habit with the medicine. It is also sometimes advisable to have recourse to salivation, to check greater evils and remove obstacles which are almost too formidable to hold out any prospect of being removed by other means. Thus persons addicted to intemperance and other depravities, and who have not sufficient controul to alter their habits, are brought into a tractable state by being salivated; for then

they can be restrained to a proper diet and withheld from their irregularities.

I have already mentioned that the quantity of any mercurial preparation necessary to be introduced into the habit to excite salivation, depends altogether on the state of the patient and several adventitious circumstances, over which the physician can exercise no controul. In some individuals the susceptibility of the habit for receiving the mercurial impression is so great, that small doses of even the mildest preparations of the medicine will produce salivation. Dr. Crampton has recorded a case in which two grains of Calomel caused extensive ulceration of the throat and exfoliation of the lower jaw, and which terminated in death. On the other hand, there are individuals of a state of habit so opposite to those I have just alluded to, that no quantity of any Mercurial, however introduced into the habit, can excite salivation. But these idiosyncracies are rare; yet they should be kept in remembrance in guiding us in the administration of Mercurials.

Physicians had early remarked that the most urgent symptoms of syphilis often disappeared before the salivation commences; and that the disease is cured where little or no evacuation from the salivary glands has taken place. From these and other circumstances, some practitioners very early rejected the plan of salivation. Almenar, a Spanish physician, who wrote in 1460, was the first who attempted to keep down and moderate salivation by the administration of purgatives. He was followed by very few for nearly half a century; but at length this was the general practice for a considerable period, and continued so until 1718, when the custom of exciting profuse salivation was revived, and followed for upwards of half a century.

It is now generally agreed that much salivation should be avoided, and the Mercurials pushed as far as they can be without exciting it. The fœtor of the breath, the gums becoming sore and spongy, are sufficient indications that the habit is charged with the Mercury, and that the mercurial irritation necessary for the cure of the disease has been duly excited. The time which this method requires may be re-

garded as an objection to it; but this is a weak objection. If, however, we consider that much time was occupied in preparing the patient for salivation, and that the extension of the convalescence after its conclusion was great, both the plans will be found to be nearly equal. The charge, that relapses are more frequent when salivation is not resorted to, is as untenable as the former position, if due precaution be observed.

Upon the whole, it is obvious that practitioners formerly administered immoderate doses of Mercury, and at too short intervals; exciting violent salivation, which inflicted calamities upon the patient scarcely inferior to what might have occurred from leaving the disease to its natural course. Neither were the practitioners of those times at all aware of the quantity of Mercury required to effect a radical cure; they were not aware of the period necessary for employing the remedy, "nor competent to distinguish," as Mr. Pearson remarks, "between the proper effects of the venereal poison and the pernicious consequences of an injudicious practice." Much evil attends the throwing in Mercury so as to induce salivation suddenly. The effects are often so severe that it is requisite to suspend the use of the remedy; and when the evil is set aside, to begin again to use it with caution. It may not be altogether out of place to mention here, that sometimes salivation does not occur during the period in which the use of the Mercury is continued, but after its administration has been abandoned. If we can trust the authority of Swediaur, several months have elapsed before the action on the salivary glands has occurred. Salivation may also happen a second time, after a considerable interval, without the introduction of any more Mercury into the system. Mr. Bromfield, who had ample opportunity for observation in the Lock Hospital, has mentioned several instances of this kind; in one of which the interval was three months; in another, a periodical salivation occurred at intervals of six weeks, for a whole year after the use of the Mercurials was abandoned. These, however, are uncommon cases. In fulfilling the second intention, that is, to excite a moderate mercurial irritation in the habit, it is necessary to keep in view the conclusions to which we have

arrived regarding salivation. In the milder forms of the disease, a very moderate mercurial action only is requisite to overcome the morbid state which the introduction of the virus into the system has produced ; and every step beyond this point to which mercury is carried must be considered as injurious to general health. Mercury acting upon a sound constitution must be regarded in the light of a poison : and there cannot be a stronger proof of this than the influence of a mercurial atmosphere on those workmen whose labours expose them to the operation of this poison ; such, for instance, as miners in the quicksilver mines, gilders, barometer makers, and others. These workmen are frequently attacked with what is termed shaking palsy ; a disease characterized by quiverings and tremors of the arms, followed by convulsions of both upper and lower extremities, and which, when extended to the other parts of the body, render it impossible for the individuals affected either to walk or to raise food to their mouths, or even to speak or to chew ; and which, if the atmosphere inducing the disease be not removed from them, terminates in stupor, delirium, and death. It is a curious fact, that those most liable to these tremors are not susceptible of salivation.

The difficulty of knowing how far salivation may be pushed is considerable. If the Mercurial be applied through the medium of the surface, even where there is ulceration of the tonsils, in the form of what is termed the excavating ulcer—that is, a hollowed-out state of the tonsil, as if a portion had been scooped out, with ash-coloured sloughs, and a red, tumid margin—as soon as the gums are affected, the quantity of the ointment should be diminished one half ; but it must be continued in sufficient quantity to keep up this degree of tenderness for a sufficient length of time, not only to overcome the diseased action, but also the habit superinduced by the syphilitic virus : and the best guide in this respect is the healing and cicatrization of the ulcers, and the complete desquamation of the diseased cuticle when blotches occur. Sometimes, after the conclusion of a mercurial course, a state of throat, not very dissimilar from that which I have described, although less severe,

may supervene some irregularity or imprudent exposure to weather. This is often mistaken for a return of the disease, whereas it is truly a consequence of the remedy ; and, consequently, a return to the use of mercurials should not take place : but if a longer time has supervened between the leaving off the mercurials, and this sore throat is accompanied with a papular, or a scaly copper-coloured eruption, we may then conclude that it is not the effect of the remedy, but a renewal of the disease.

This is not the place for entering upon the consideration of all the details necessary to be considered in the treatment of syphilis : it is only with the remedy and its effects that we are occupied ; and I may conclude this part of our enquiry by remarking that it is not the violence of the mercurial action induced, but the maintaining a moderate degree of it for a sufficient length of time, that is likely effectually to destroy the syphilitic action.

With regard to the topical application of mercurial preparations, it must be remembered that corrosive sublimate, applied to a wound or ulcer, occasions dangerous symptoms : even where the skin is entire, it must be used with caution.

We have now to enquire what are the preferable modes of exhibiting mercurials, and what are the best preparations for fulfilling the above intentions in the treatment of syphilis ?

All the preparations of Mercury, when properly administered, cure syphilis ; but, nevertheless, among so many, and those receiving their activity from different sources, some must be preferable to others.

The external applications are either the ointments, or fumigation, or lotions. Let us examine how far each of these is applicable to produce the excitement necessary for the cure of syphilis.

The great advantage attending the use of the ointments is the facility which they afford of introducing a large quantity of the remedy into the habit before profuse salivation is likely to be produced : but their use is not unattended by some inconveniences. For instance, peculiar states of the constitution, or idiosyncrasy, may produce so much torpor or want of

action in the cuticular absorbents, that much time may be expended in the application of the remedy, and little be taken into the system. The mode in which the friction is employed is also of importance: but, as this must be left to the patient, we have little or no controul over it; so that the quantity absorbed cannot be ascertained from the quantity employed. This mode of using the remedy also is disagreeable to many, and prevents that privacy which the nature of the disease and circumstances frequently demand in the management of its cure. Besides, owing to the extreme irritability of some persons, the friction produces eruptions upon the skin, which interrupt the free and continued employment of the remedy.

The two blue ointments, which differ only as to strength, are most commonly employed. Ointments also with the protochloride, or the white precipitate, or the grey oxide, are sometimes used in the same manner; but none of them remove either the local symptoms of the disease, or affect the general system in so short a space of time as the strong mercurial ointment of the Pharmacopœias.

The quantity of the ointments to be employed has been already mentioned. It is curious to look back into the practice of some of our best old authors, when they mention this remedy. Thus, Sydenham, and the practitioners of his time, used an ointment composed of one part of Mercury and two of lard; and of this one ounce was rubbed in for three successive nights. The consequence was severe salivation, which was kept up by the internal use of turpeth mineral, or by Calomel, exhibited whenever the flow of the saliva flagged. The patient was kept during the whole time in bed, and the most rigid abstinence observed.

With respect to the time for using the ointments, the evening is chosen; and certainly, as far as regards the convenience of the individual, this is to be preferred: but, if we consider that, after repose, the skin is more elastic and soft, and that the vigour of the absorbents must be in accordance with that of the general system, we should be disposed to prefer the morning for this operation. The friction must be

assiduously employed until the whole of the ointment be absorbed ; and, as I have already stated, the operation should be performed by the patient himself. It has been recommended, by some writers on Syphilis, that, when the patient is obliged to continue his occupations during a mercurial course, the ointment may be applied to the soles of the feet ; so that the friction of the exercise which is taken during the day may cause its absorption. I have seen this practice followed ; but the results were not such as authorize me to recommend it.

Owing to the tediousness and labour of preparing the common mercurial ointment, turpentine, sulphur, oil of eggs, saliva, and a variety of other matters, have been employed to facilitate the oxidizement of the Mercury. But ointments thus hastily prepared are found by experience to be less efficacious than the common blue ointments, properly and slowly manipulated. The grey oxide ointment of the Edinburgh College, being prepared with an oxide in a state of very minute division, has been supposed to be well adapted for mercurial frictions ; but, from whatever cause I will not pretend to determine, it does not, if I may be permitted to use an apt but homely expression, work so well as the common ointment. M. Simouin has proposed a method of preparing the blue ointment, which seems likely to answer the purpose, and is said to form an unexceptionable preparation. I have made the ointment in this manner, but have had no experience of its remedial efficacy. M. Semouin takes ℥viii of Mercury and ℥viii of lard : ℥iv of the latter are melted in a bottle, into which the Mercury is introduced, and then briskly shaken until it have acquired the consistence of syrup ; after which the mixture is rubbed up in a mortar with the rest of the lard. The whole process is finished in half an hour.

Ointments are also prepared with the red oxides ; but they are too irritating for general application, although they are excellent topical dressings in syphilitic ulcers.

I have already referred to another method of introducing Mercurials into the system by friction, that of rubbing Calomel on the internal surface of the cheeks and gums.

It was suggested by Mr. Clare, and undoubtedly has its advantages. From three to four grains of Calomel, either in the form of powder, or combined with mucilage, is to be rubbed upon the gums. If the saliva be swallowed during the operation, diarrhœa is apt to occur, which is an objection to this method of proceeding. It causes salivation; but not, as might, *a priori*, be supposed, from any topical stimulus communicated to the salivary glands and their excretories; but from being absorbed, and causing the mercurial febrile action as effectually as any other method of using the remedy. We have also sufficient evidence that the protochloride is decomposed in this case; as gold worn in the pocket is whitened in the same manner as when the blue ointment is employed. It is certainly a cleaner mode of affecting the system than that by the ointment. It cures the disease, and even in a shorter time than the ointment; but it is apt to excite salivation too soon, and to carry it too far.

In using the frictions, it is better that the effect should not be sudden; as, in that case, the continuance of its influence on the habit is too evanescent, if a full charge of the remedy be not accumulated in the body; and particularly if the salivation proceed to an extent, as sometimes occurs, of obliging the application of the ointments to be discontinued.

The form of introducing Mercurials into the system by fumigation was suggested soon after the discovery of the powers of Mercurials as remedies for syphilis. Cinnabar was the preparation employed; and, as a relic of a prior practice, gums and aromatics were added to the Mercurial, and occasionally sulphur and arsenic. The fumigations were applied to the whole body; but, owing to the dangerous results that occasionally followed this mode of practice, it soon fell into disuse. In 1736, a person of the name of Charbonnier, whose operations were superintended by the faculty in Paris, revived the use of fumigations on a new plan: but, many having fallen victims of his treatment, fumigations again fell into disuse, and were neglected until 1776, when they were again revived by M. Lalouette. He discarded the sulphurets, and employed Calomel, or some similar preparation, and the oxides, using a fumigating machine invented by Nicolas de

Blegny, in 1683, a little modified. The plan of this individual was fairly put to the test of experiment by the late Mr. John Pearson, in the Lock Hospital; and the conclusions he deduced from his trials were—"that where checking the disease suddenly is an object of great moment, where the body is covered with venereal ulcers, or where the eruptions are large and numerous, so that there scarcely remains a surface large enough to absorb the ointment, the application of the vapour of Mercury will be always attended with evident advantage." But he found it difficult to introduce a sufficient quantity of Mercury, by this means, into the animal system to prevent a relapse; and he therefore concludes his account of his experiments in these words:—"I consider it (fumigation) as a mode of treatment by no means eligible in general practice." Mr. Bacot, in his excellent and highly instructive *Essays on the Nature and Treatment of Syphilis*, published in the second and third volumes of the *Medical Gazette*, mentions the work of Dr. Rapon at Paris, in which the advantages to be derived from fumigation are minutely and fairly stated. Mr. Abernethy, in my opinion, has proposed the simplest and the best mode of fumigation. He places his patient in a vapour bath, in a complete suit of under garments, with a cloth covering the bath. Two drachms of the grey or protoxide of Mercury are then put upon a hot iron placed within the bath. The patient remains in it for fifteen or twenty minutes, in which time the whole body becomes covered with a white powder. He is then put to bed, in the same clothes, and lies in them until the next morning, when he is placed in the tepid bath. Mr. Abernethy regards this as the most gentlemanly way of curing syphilis; and says, that he has seen it produce salivation in forty-eight hours. In the few instances in which I have seen it employed, it has not acted so quickly as Mr. Abernethy mentions.

The last method of topically introducing Mercurials into the body is by means of lotions or baths. The perchloride or any of the preparations soluble in water are used for this purpose; and the body, or a portion of it, is immersed in the solution. Syphilis has been thus cured; but, owing to the

dangerous excitement caused by these baths, when any portion of the surface is abraded, the practice is not to be recommended.

In treating of the comparative merits of those preparations of Mercury which may be taken into the stomach, I will take them in their order in the Table of Excitants. Among the protoxides, the first preparation fitted for internal use is the common blue pill; and, when properly prepared, this is the best of this set of remedies, because it is the mildest of those which certainly mercurialize the habit. It seldom, unless improperly prepared, incommodes either the stomach or the intestines. But, when turpentine has been used to assist the oxidizement of the Mercury, or when the conserve of roses with which it is made contains sulphuric acid, the blue pill is apt to gripe and run off by the bowels. From the mildness of its operation, the blue pill is peculiarly well adapted for those whose habits have been previously debilitated, or who are naturally delicate. In some persons, however, owing to idiosyncrasy, it proves too active, unless it is corrected either by opium or by the addition of a few grains of rhubarb, given in the morning, which, by supplying a little tone, renders the intestines less irritable, and consequently less susceptible of those irregular contractions which cause griping. During the administration of the blue pill, the use of acids should be avoided; and, if the stomach be in an acescent state, the superabundant acid should be neutralized and carried through the bowels, or the stomach should be emptied by means of an emetic, and alkalies afterwards exhibited to allay the irritability of the organ. In doses of from five to twelve grains, given every morning and evening, it soon displays its influence upon the habit: salivation can be as certainly produced by it as by any of the more acrid preparations; and, at the same time, its activity is more under controul than that of any of these. When a dyspeptic state of the stomach accompanies syphilis, Hydrargyrum cum Creta is sometimes preferred to the blue pill: it may be given, in doses of a scruple or half a dram for an adult, every morning and evening. But the effect from this preparation is slow and uncertain. In cases of congenital syphilis, how-

ever, it is the only preparation which can be used, as it may be given to young infants.

The grey oxides, although precipitated from active salts, yet are mild preparations of the metal in the first state of oxidizement; and that form of it prepared by precipitation from Calomel has been regarded by several distinguished practitioners as more certain and yet milder in its effects than the blue pill. They affirm, with truth, that it incommodes the stomach and bowels less than the blue pill; that, from its more minute mechanical division, and consequently being more perfectly combined with oxygen, it acts with greater certainty than that preparation; and that it is more easily prepared, and less likely to be adulterated.

The peroxides, particularly the red oxide, *per se*, were formerly much employed as internal remedies in the cure of syphilis. From the difficulty, however, of preparing the red oxide, it fell into disuse until the time of John Hunter, who considered it one of the best of the mercurial preparations. It is, however, very apt to induce griping, diarrhœa, and tenesmus; and, therefore, Mr. Hunter always combined it with opium and oil of cloves; but, in spite of these combinations, it cannot be given in doses exceeding half a grain without greatly incommoding the bowels; and, therefore, it is now seldom employed: nor is this neglect undeserved, since it possesses no advantages over other preparations, which are less acrid and virulent in their operation. The red oxide, prepared by the decomposition of the nitrate, is even more objectionable than the red oxide *per se*: both preparations are now entirely confined to external use, as topical Excitants.

The *Chlorides* are very active preparations. The protochloride, or calomel, is a more efficient preparation than any of the oxides. In doses of four or five grains, however, it generally purges, demonstrating that, although insoluble in water, it is soluble in the gastric juice. This is more easily explained, since the experiments of Dr. Prout have demonstrated the presence of muriatic acid in the gastric secretion; and, consequently, it is partially converted into the perchloride, or a state approaching to it,

in the stomach. In doses smaller than those which excite purging, it is a preparation well adapted for the cure of syphilis, and is less apt to induce sudden salivation than any other ; it is, therefore, preferred for those who are readily salivated, and where the bowels are not very irritable ; and even in those with irritable intestines, it is more gentle in its operation than the peroxide. It should be given, at first, in doses not exceeding a grain ; and, if this run off by the bowels, or gripe, opium may be added to it. Combined with antimonials, it is a diaphoretic ; with squill and foxglove, a diuretic ; and it aids the force of the milder purgatives, whilst it moderates the acrimony of the more drastic. It is therefore peculiarly well adapted in those secondary cases of syphilis characterized by cutaneous eruptions ; and, when exhibited to infants in these cases, it produces much less disturbance of the abdominal viscera than would, *a priori*, be expected. The best form of administering calomel is that of pill, conjoined with small doses of opium : or, when pills cannot be swallowed, and the form of powder is objected to, it may be mixed with water, by means of mucilage of gum tragacanth, which, owing to its spongy, insoluble nature, is well adapted to suspend a heavy, insoluble powder, in a moderate quantity of fluid. Whatever may be the chemical difference between the sublimed and the precipitated calomel, there is, undoubtedly, a considerable diversity of action between them. The precipitated calomel irritates the stomach and bowels more than the sublimed preparation ; nor can it be used for so long a time, nor in such large quantities. -

The perchloride is the most active of all the Mercurial salts. It has been supposed that it was first used as a remedy in syphilis by Basil Valentine. Be this as it may, it was first introduced, for this purpose, into England by Richard Wiseman, early in the 17th century : but its employment was violently opposed at this period ; and it was consequently neglected until Van Swieten recommended it as a preparation of singular efficacy against every form of syphilis. Mr. Pearson supposes that Swieten derived his knowledge of the efficacy and safety of this remedy from Dr. Sanchez, who

resided many years at Petersburg, where the remedy was used long before its introduction into Great Britain. Of three hundred persons cured by the corrosive sublimate, in 1754, all remained well in 1755, and two hundred more were added to the list: but the most striking results of its success are recorded by Dr. Locher, who was physician to the Venereal Hospital in Vienna, in which the perchloride had been able to effect a complete cure in 5000 cases. Many respectable authorities in this country might be brought forward in its favour: in France, M. De Horne, who made experiments to ascertain its efficacy, by order of the government, expressed himself satisfied that the cures performed by it were real and permanent: and Dr. Cirillo, a Neapolitan physician, who used it externally as an ointment, affirmed that it is milder and less uncertain than any other Mercurial in general use. Besides rubbing in this ointment, Dr. Cirillo employed warm baths, once in three or four days; and he assures us that the mouth is seldom made sore, and that, by his method, the medicine operates principally on the skin and the kidneys. In opposition to these statements in favour of the perchloride, we find that Mr. Bromfield, after employing it in the early part of his practice, asserts that it cannot be depended upon: an opinion that was supported by Mr. Gataker, and also by M. Louis, both men of great professional eminence and high authority upon this subject. The latest writer of reputation who has decided against it, is the late Mr. John Pearson. He admits that it will sometimes succeed in curing the primary symptoms of syphilis, yet contends that it is a medicine which cannot be confided in where secondary symptoms have appeared. From its acrimony, it frequently gripes, and causes spasmodic contractions when taken even in small doses; and occasionally has the power of producing cough, hæmoptœ, consumption, and similar diseases: and when it has apparently cured syphilis, the symptoms have frequently returned. It is, nevertheless, one of those preparations on which my experience has taught me to rely in cases of syphilitic eruptions; particularly those which assume the characters of psoriasis or of lepra. In these cases I generally order the perchloride in solution in nitric acid, in the

proportion of one grain to fʒi of the diluted acid, so that six minims contain the sixth part of a grain of the perchloride. I have generally given, at the same time, either the decoction of sarsaparilla or that of elm bark; and, by gradually increasing the dose to ten minims or one-sixth of a grain of the salt, I have seldom failed in curing these eruptions. The remedy must be continued for some time after the eruption has disappeared, the doses being gradually diminished. I have never seen it produce salivation when thus administered. Mr. Pearson admits that the perchloride may prove beneficial at the commencement of a Mercurial course, "to bring the constitution under the influence of Mercury at an early period, or during a course of inunction, with the intention of increasing the action of simple Mercury. He also admits its efficacy, after a course of friction, to prevent a relapse."

The perchloride may be used in the form of pills, in doses of from $\frac{1}{8}$ to $\frac{1}{6}$ of a grain, combined with opium. Dr. Dzendi, of Hallé, affirms that he cures syphilis radically by giving it in pills, containing $\frac{1}{12}$ only of a grain, beginning with four a day, and gradually augmenting the dose, until thirty are taken in the same period of time. If they purge, he adds a few drops of tincture of opium to each dose; if the gums become spongy, he washes them with an astringent lotion; and during the whole course the food is reduced one fourth. Dr. Dzendi, however, does not solely confide in these pills, but administers the decoction of sarsaparilla after they have been continued for some time. I mention this method of Dr. Dzendi, to expose the vacillation of opinions at all periods on the efficacy of certain medicines. The perchloride has been given more frequently in solution in alcohol, a form of exhibiting it which was first suggested by Van Swieten. His solution contained half a grain to the fluid ounce of alcohol; and of this solution a table spoonful was given for a dose. It was generally conjoined with opium, or some mucilaginous liquid, to prevent gripings. The perchloride has also been occasionally exhibited in distilled water, with a portion of muriate of ammonia to facilitate its solution, and to increase its tendency to pass off by the kidneys and the

skin. The proportion of the muriate of ammonia is double that of the perchloride, and each fluid ounce of the solution contains half a grain of the perchloride. As far as syphilis is concerned, the chief use of the perchloride is to make a sudden impression when any particular symptom is gaining ground rapidly: in these cases, if it produce griping and purging, it should not be persisted in. As an alterative, in affections of the throat in which there is some reason for thinking that the remains of a syphilitic taint are lurking in the habit, the perchloride dissolved in nitric acid and given in doses of $\frac{1}{10}$ of a grain, with a course of sarsaparilla or decoction of elm bark, has proved successful in my practice. I may mention that, in such cases, I have seen no benefit derived from the use of the remedy, if the patient be permitted to take his usual diet, and to use, even moderately, either wine, spirits, or porter. It seems essential for securing the efficacy of the perchloride, that no other stimulant should interfere with its action on the habit; and if we admit the theory that the fever of syphilis is to be knocked down by setting up another in the habit, we can easily understand how its influence may be interrupted by the use of other stimulants, whether dietetical or remedial. In cases, therefore, of this description, the diet should be milk, combined with farinaceous matter; and a very moderate allowance of light animal food, such as mutton and poultry.

It is unnecessary to proceed farther in our examination of these preparations: the number I have already brought before you affords ample scope for your choice; it only remains to say by what principles your selection of one more should be determined.

It is true that all the preparations, when properly used, will cure syphilis; and therefore a practitioner may, to a certain degree, please his fancy in the selection; but still, where a guide is desired, the few that are requisite should be pointed out. Those for topical application may be reduced to the common ointment; the solution of the perchloride; the black wash, formed by triturating the protochloride with lime water; and the red oxide by nitric acid. As an external means of introducing Mercury into the habit, the

common ointment may supersede every other preparation ; and for internal exhibition, the common blue pill and the grey oxide are adequate for every purpose.

In curing syphilis by Mercury, several precautions are requisite to be observed during the use of the medicine ; and it is also necessary to know that many circumstances may interfere with its regular operation. Thus, with respect to climate, the human system is in general more susceptible of the impression of medicinal agents in warm climates than in cold ; and this holds, in a special manner, with respect to Mercury in the cure of syphilis. A smaller quantity of Mercury, and a shorter period for its application, will suffice to cure the disease in a warm climate than in a cold. It was the custom in the time of Sydenham to send syphilitic patients to the south of France, as experience had demonstrated that a much larger quantity of any Mercurial preparation can be thrown into the system without producing salivation in that climate. For the same reason Mercury is more advantageously used in summer than in winter.

Women are more easily brought under the Mercurial action than men ; and, as it augments the discharge of the catamenia, the use of the Mercurials should be suspended for some days previous to, and during the continuance of this periodical evacuation. In pregnancy, also, Mercurials should be used with great caution. It is not so injurious during nursing ; and, when infants are affected with congenital syphilis, whether the exhalation from the body of the mother, or the milk being impregnated with the remedy, communicate the Mercurial influence to the system of the child, I will not venture to determine, but it is certain that the disease in the child has frequently been cured through the system of the nurse.

The sanguine and choleric are more susceptible of the Mercurial impression than other individuals ; and, therefore, in syphilitic affections which require, or seem likely to require, a protracted course of Mercurials, great caution is necessary not to bring the habit suddenly under the full influence of the remedy. Some idiosyncracies are occasionally met with, which prevent the free use of Mercury in

certain individuals ; and as this sometimes occurs in reference to peculiar preparations and not to others, it is proper, when a person seems to suffer from the preparation in use, to try others before pronouncing that his system will not bear Mercury, and thereby depriving him of the only chance of having his disease cured. When symptoms of either erythema or erythismus display themselves, the use of the remedy must be instantly suspended, and the irritability of the habit subdued by a free exposure to cool dry air, and by a removal into the country.

It now only remains to take a brief view of the various theories which have been advanced to explain the mode in which Mercury effects a cure in syphilis.

If we take a retrospective view of the various theories which have been advanced, we find that the mechanical physicians referred every thing to the physical properties of the medicine ; whilst the chemists ascribed all either to the solubility of the Mercury in the animal mucus, and its action on albumen, or to its chemical union with the syphilitic virus neutralizing it, and thus depriving it of its acrimony in the same manner as that of an acid or an alkali is destroyed by the formation of a neutral salt. This last idea fell to the ground before the fact that syphilis cannot be communicated to a healthy person by inoculation with the blood of the infected person ; and although Mercurials certainly enter the system through the circulation, yet, were the blood tainted by the virus of the disease, the quantity of Mercury admitted into it is too small to produce the effect of neutralization. Some writers, as Dr. White, Dr. Wolf, and others, have ascribed the sanative effects of Mercury in syphilis to its expelling the virus from the system by evacuant properties exerted on the salivary glands : but, as I have more than once stated, the excitement of salivation is not requisite for securing the powers of the remedy over the disease, and that it merely shews that the system is with the remedy. Mercury has also been supposed, by some writers, and those of high authority—as, for instance, Swediauer—merely to act by communicating oxygen to the habit, which, increasing the febrile state to a high degree,

neutralizes or renders inert the syphilitic poison. There are certainly some grounds for this opinion in the reduction of the Mercury, which post-mortem examinations have detected in various parts of the body ; and, on the faith of this explanation being correct, oxygenating substances, as nitric acid, chlorate of potassa, and similar preparations, have been employed as substitutes for Mercury in the treatment of syphilis. But the results have not infused confidence in the accuracy of the theory ; and it remains still to be proved whether the presence of oxygen can destroy the syphilitic virus when present in the system.

The last and most probable opinion is, that Mercury produces a peculiar excitement or febrile action, *sui generis*, which overcomes or destroys that induced by the virus of syphilis. This is, indeed, assuming, in the first place, that such a diversity of action is induced : but the probability of the opinion is great, when we consider, what can scarcely be denied, that the syphilitic virus exerts a specific power over the habit, interrupting in particular the healthy functions of the glandular system, and altering in a striking degree the secretions. Now, that Mercury has a powerful influence over the glandular system, is well known ; and this is rendered obvious by its effect upon the salivary glands : if, therefore, the action of Mercury be sufficient to suspend the morbid action of syphilis—and it is a law of the system that morbid actions can be suspended, for a time at least, by the influence of new actions superinduced—it is probable that that of the syphilitic poison may be overcome by that of the Mercury ; and as this can be withdrawn or subdued by the disuse of the remedy, the system is left to the influence of its ordinary and healthy functions. In presenting this theory as the one to which I incline, the reason which induces me to urge the necessity of dieting the patient during a mercurial course will be obvious. If stimulants be given at the same time as mercury, the stimulus of the mercury may not be sufficient altogether to overcome the diseased action. Perhaps I might extend this remark to almost all medicines ; and I have long entertained an opinion that the neglect of attention to diet interferes greatly with our success in all cases. To return

from this digression : I am willing to admit that the theory which I have adopted does not altogether remove the difficulty in explaining the action of mercury in curing syphilis : it may be said merely to express a fact, not to develop its cause ; but, in most circumstances, we can proceed no further.

e. AMMONIA. L. E. D. Syn. Volatile Alkali.

The last of the inorganic Excitants which we have to notice is Ammonia. This substance is a compound of nitrogen and hydrogen : it is formed in every case of putrefaction of animal and vegetable matter, and is very largely produced in foggy weather, probably owing to a partial decomposition of the aqueous fluid in the atmosphere, which, coming in contact with the nitrogen extricated from putrefying animal matter, unites with it and forms Ammonia. This theory of its formation may be questioned ; but its presence, at these times, is rendered obvious to the senses by the strong odour of Ammonia, which is exhaled in places where animal decompositions are in progress, during the prevalence of fogs.

Ammonia is found also ready formed in nature, in combination with a variety of substances, in the neighbourhood of volcanoes : it is a constituent in coal ; and, in Africa, it has been found in some mineral waters. All cruciform plants yield Ammonia.

For medicinal purposes, Ammonia is procured from the decomposition of the muriate of Ammonia by means of lime, which has a stronger affinity for the muriatic acid than the Ammonia, and consequently displaces it : the Ammonia is given off in the gaseous state ; but, being very soluble in water, it is combined with that fluid and forms the officinal *Liquor Ammoniæ*.

Ammoniacal gas is transparent and colourless, invisible, elastic, and possesses all the mechanical properties of common air. It stimulates powerfully the eyes and the nose ; has an acrid, caustic taste ; and, by its effects on vegetable blues, and on litmus reddened by an acid, it proves its affinity to alkalies. Its specific gravity is 0.5931, and 100 cubic inches weigh 18 grains. It destroys animal life, and cannot

support combustion. Water takes up 500 times its bulk of this gas without any alteration of the properties of the gas; but, independent of water, Ammonia, under a pressure of a little more than six atmospheres, at a temperature of 50° , can be rendered fluid. When oxygen gas and gaseous Ammonia are mixed together and exploded, water is formed and azotic gas remains. Ammonia is a compound of

Hydrogen 17.64, + Nitrogen 82.36 = 100:

or

3 prop. of Hydrogen = 3, 1 prop. of Nitrogen = 14, equiv. 17.

During the absorption of ammoniacal gas by water, heat is evolved: when saturated, the gravity of the solution is 0.85; in which case 100 grains of water contain 35 grains of Ammonia, or 494 volumes of the condensed gas in 1 volume of water: but the solution of Ammonia ordered by the London College, which is of the specific gravity of 0.960, consists of only 10 parts of Ammonia and 90 parts of water in 100 parts.

2. *Carbonate of Ammonia*.—Ammonia combines readily with the acids; and, if muriate of Ammonia and carbonate of lime be mixed in the proportions directed in the London Pharmacopœia, and exposed to a gradually raised red heat, a sub-carbonate of Ammonia is formed, which operates on the animal body as an Excitant in the same manner as the Ammonia. Carbonate of Ammonia possesses the sensible properties of pure Ammonia, which it exhales; so that turmeric paper, held over it, is tinged brown. It is soluble in cold water without decomposition; but hot water decomposes it with effervescence. When kept in an open bottle, the superabundant Ammonia escapes, and the salt becomes neutral and inodorous. In its perfect state, it consists of Ammonia 28.81, + Carbonic acid 55.93, + water 15.26, = 100: or Carbonic acid 3 prop. $(22 \times 3) = 66$, Ammonia 2 prop. $(17 \times 2) = 34$, water 2 prop. $(9 \times 2) = 18$, making the equivalent = 118. It is decomposed by the acids, the other pure alkalies, lime-water, muriate of lime, magnesia, alum, bitartrate and super-sulphate of potassa, hydrochloride of mercury, the salts of lead, and the sulphates of iron and of zinc. These substances, therefore, should not be ordered in combination with it in prescriptions.

As this salt is usually found in the shops, it is nearly inodorous: this, according to Mr. Phillips, is owing to the escape of the carbonate of Ammonia in the state of gas; for he supposes this salt to be a compound of carbonate of Ammonia and bicarbonate of Ammonia with water.

With regard to the effects of Ammonia on the animal economy, I have already stated that it rapidly destroys life. It is probable that this may arise from spasm of the glottis and consequent suffocation, as there is scarcely time sufficient for inflammation to produce its effects. In its concentrated state, in water, it acts on the animal body as an escharotic. In its diluted state, but stronger than ordered by the Pharmacopœia, it excites powerfully the living solid, inflaming the part to which it is applied, and causing vesication and suppuration: largely diluted, it produces a primary exciting effect on the nerves of the stomach when it is taken into that viscus, which is rapidly propagated over the system; but its effects are transitory; and thence it is regarded as a diffusible Excitant. Its use is indicated in low states of the habit in which there is a deficiency of nervous power, and in torpid states of the system, as it is said to rouse the powers of the nerves without quickening, in an equal ratio, the sanguiferous system.

In a practical point of view, Ammonia is employed as an Excitant in many diseases. It is peculiarly indicated in the latter stages of typhus, when tremors and subsultus tendinum occur: it is given in combination with aromatic confection and other cordials; but it must not be given in sufficient quantity to exhaust the excitability. Although it would be highly improper to order it in the early stages of pneumonia, or at any period of that disease when active inflammation is present, yet, in the latter stages of it, when the bronchial tubes are loaded with phlegm which cannot be expectorated, Ammonia, in the gaseous state, largely diluted with common air and inhaled into the lungs, or the solution, diluted with water and taken into the stomach, promotes expectoration, and is the best mode of relieving the oppressed state of the respiration. In long-continued paralysis, which does not depend on local affection of the head, it may be used with advantage. Never-

theless, in some diseases of the head, when there is no febrile nor inflammatory symptoms present, and the vital powers require to be sustained, Ammonia and its carbonate may be advantageously prescribed. Under such circumstances, it is given in mania, in doses of from five to eight grains. In states of asphyxia and syncope, the stimulus of Ammonia is highly useful; but, in asphyxia, some caution is requisite. In dyspepsia connected with hypochondriasm, it not only proves a useful stimulus to the stomach and nervous system, but it combines with the acid which usually, in this disease, superabounds in the stomach, existing partly in the gaseous state, and thus operates, by its chemical properties, in relieving the disease. In all spasmodic affections, Ammonia is perhaps one of the best stimulants that can be employed. In convulsive affections, such as asthma, hooping cough, and similar diseases, it has been regarded as exerting some specific influence; but it is to its stimulant power that its beneficial effects are to be ascribed; the spasms, in these diseases, depending altogether on that increased irritability of the system which accompanies debility. In hysteria, the diffusible character of the stimulus of Ammonia renders it a medicine well adapted for such cases during the paroxysm; but it can be of very little service in the intervals, although it is often prescribed. It is not easy to explain the manner in which Ammonia operates when it is taken into the stomach for warding off the effects of the bites of poisonous snakes, unless we admit that the virus introduced into the wound acts as an immediate and direct sedative to the nervous system, and that the Ammonia, by sustaining the nervous energy, enables the system to withstand the influence of the poison until it expends its power. It may operate somewhat in the same manner in relieving syphilis, for which it was not many years since regarded as a specific superior to mercury; but experience, which tends more and more to confirm the influence of mercurials, when properly employed in this virulent disease, has done nothing to confirm our confidence in Ammonia, which is, therefore, now seldom used in syphilis.

Ammonia may be given, in its state of *Liquor Ammoniae*,

in combination with muriate of lime and any of the salts of baryta and with tartarized iron; but it is incompatible with acidulous salts and other metallic salts. It may be administered in any bland mucilage or emulsion, or in bitter infusions, or in milk, in doses of from ten minims to half a dram.

The subcarbonate should never be ordered in the solid form, as it is apt to prove emetic. The dose is from five grains to a scruple, dissolved in any mucilaginous or bitter infusion.

The London College order a solution of the subcarbonate, in the proportion of four ounces to a pint of distilled water. It may be given in doses of thirty minims to a dram in any bland liquid.

MENTAL EXCITANTS.

There can be no doubt that all our agreeable feelings are more or less causes of nervous excitement, and, like many of the material Excitants which have been described, their excess is followed by collapse, and may even extinguish life altogether. In taking this view of the subject, it might be supposed that many more mental emotions than *Joy* and *Impetuosity* should be enumerated as Excitants: but as material agents are regarded either as Excitants or Tonics, according to the degree of the rapidity and the intensity of their effects, so mental emotions, which increase action, may be arranged in the one or the other of these classes.

a. Joy.—Many simple pleasurable feelings—namely, satisfaction, hope, and confidence, operate as direct stimulants to the nerves, and thence to the sanguiferous and muscular systems; but the increase of action which they induce is moderate in degree, and may be continued for a considerable length of time, not only without producing exhaustion, but with the utmost benefit to the system; diffusing equably the circulating fluid; aiding absorption, secretion, and excretion; and so favouring assimilation as to increase the healthy action and the natural vigour of every important organ. These emotions, therefore, in the strictest meaning of the term, may be regarded rather as Tonics than as Excitants. *Joy*, on the other hand, produces effects closely resembling those

which follow a powerful material Excitant ; the action of the heart and arteries is suddenly augmented to such a degree that palpitation sometimes ensues ; whilst, as might be expected, the animal heat and the perspiration are considerably increased ; more blood is consequently sent through the capillaries ; the face glows, the eyes sparkle, and are even sometimes suffused with tears ; whilst the breathing becomes fuller and quicker than usual. The mental functions of the brain are not less excited than those of the body ; the imagination takes a more excursive range ; the most pleasurable of the past scenes of life are again pictured in the mind, the future teems with only gay and delightful anticipations ; every task seems easy, every labour light, and schemes of undertakings the most momentous and difficult, appear already accomplished, and crowned with the most brilliant success. But, besides these illusive impressions, the excitement of Joy quickens the senses, the eyes are turned with celerity towards every object, which is instantly and clearly perceived ; the ear is alive to every sound ; the taste and the touch are acutely sensitive ; and every bodily action is more prompt and energetic.

It is not my intention to offer even a conjecture respecting the nature of this powerful Excitant ; indeed, it would be altogether out of place here to enter the labyrinth of metaphysical disquisition, or to offer any surmises respecting that mysterious communication which exists between “ the sentient, thinking, and active principle within us,” the intellectual portion of our frame, and the material part of our body. It is sufficient for us to know that Joy operates as an Excitant, and to trace its therapeutical influence.

The states of the habit in which Joy is most likely to display, very obviously, its exciting influence, are those of diminished action in diseases, particularly of a chronic character, in which languor and debility exist ; such as Melancholia, Hypochondriasis, Dyspepsia, and Chlorosis. It is not easy to say in what manner Joy can be applied as a therapeutical Excitant, except in the communication of good news to the afflicted ; but could it be administered with a proper regard to time and quantity, it is well adapted for aiding in

relieving the morbid conditions of the body just referred to, and likely to be productive of highly beneficial effects: many cases, were it necessary, might be detailed in proof of the accuracy of this assertion*.

But as Joy, like every direct Excitant to the nervous and irritable fibre, exhausts the principles on which the functions of the vital solids depend, so, as I have already hinted, excessive Joy may become an injurious agent, and even temporary delirium and epilepsy may ensue. This is particularly the case where Joy acts on persons suffering under grief or any other depressing passion; for, in such a state, the irritability being, as it were, accumulated in the body, the susceptibility of impression is greatly augmented; and, consequently, for the same reason as the application of much heat to a frost-bitten limb is followed by gangrene and the death of the part, sudden transitions from grief to extreme joy are at all times hazardous, and often prove mortal. The influence of this Mental Excitant, in these cases, is like the blaze of an electric corruscation: the instant it has passed, the extent of its depredations are exposed; whilst it illuminates, it consumes its victim. Besides the well-known case of the Roman matron, mentioned by Livy, lib. xxii, and those found in other classical writers, several well-authenticated cases of this kind, more fitted for our consultation, are collected in Haller's Physiology (vol. v, p. 581). The necessity, therefore, of caution in the employment of so powerful an Excitant scarcely requires to be mentioned.

b. Impetuosity reacts upon the brain and nervous system nearly in the same manner, and with equal energy, as extreme joy. It is, however, a voluntary act, although it often occurs without deliberation, I may almost say without consciousness. It is placed in the table of Excitants rather to afford an opportunity of pointing out to the student and the inexperienced practitioner the necessity of guarding the debilitated from indulging in it, than to point out its use as a remedial agent. The suddenness and fatal force of its impression are well illustrated by the following case, which came

* Lory de Melancholia, tom. i, p. 57. Trellianus, lib. xi, p. 17.

within my own observation. A gentleman, in the advanced stage of phthisis, was visited by an old friend, whom he had not seen for many years: the conversation turned upon an event in which the poor invalid felt deeply interested: in relating it he became greatly excited, rose from his seat, and displayed an unusual impetuosity of manner: but, he had scarcely concluded the narrative ere he sunk into his chair and instantly expired. It is easy to conceive that, in such a state of eager excitement, the effects are likely to be more strikingly obvious upon the thoracic viscera than any other set of organs; even in a state of health, it causes an unusual glow of warmth in the præcordia, the pulse beats quick, and a peculiar sensation is felt, which is not erroneously referred to the heart.

GENERAL EMPLOYMENT OF EXCITANTS AS REMEDIES.

On this part of our subject I shall be very brief; as many of the remarks which would necessarily have been brought forward now, have already formed part of the details in the descriptions of the particular Excitants.

The great number of substances which operate as Excitants leaves the practitioner ample opportunity for selecting that one which is most likely to answer the indication to be fulfilled: but, before doing so, it is necessary that several circumstances should be taken into consideration, and especially whether the impression is to be confined to the digestive organs, or extended to the circulating, or to the cerebral and rachidien systems.

The substances chiefly useful for the first-mentioned purpose are those which contain volatile oil in combination with tannin, extractive and the bitter principle; namely, some of the roots and barks which have been described. These have been found most beneficial in debility of the digestive organs, particularly in that sickness which frequently arises from chronic weakness of the stomach; and in all cases of deficient action of that organ; but they ought rarely to be employed alone, except in spasmodic pains: and even when the dyspeptic affection is grafted upon an hypochondriacal condition of the habit, combined volatile oil only should be em-

ployed. Besides those diseased states of the stomach already mentioned, Excitants have been found serviceable in cardialgia and flatulency; their administration is also clearly indicated in various affections of the intestinal canal; for instance, internally in colic when no inflammatory action is present; and externally, as counterirritants, when it is present and is of a chronic or subacute character: in flatulent colic and flatulent cholera, the warmest carminatives may be had recourse to, even under the utmost violence of the pain. In the state of collapse, in spasmodic cholera, the most liberal use of the most powerful Excitants, externally under the form of the hot air bath, and internally under the forms of carminatives, and the most diffusible stimulants, has been much resorted to with little decided advantage; but the pathology of this disease is still too obscure to admit of a decided opinion upon the subject. What has been stated under the head of Mercury, Caloric, and Iodine, prevents the necessity of extending our remarks on these articles.

When we reflect that one effect of Excitants is to stimulate the stomach to increased action, it may appear inconsistent to prescribe remedies of this class in cases of insatiable voracity; but their utility is undoubted, and they have been employed from the time of Galen, who recommended brandy and water, in small but frequently repeated doses in diseased appetite.

During the paroxysm in atonic gout, especially when the stomach is affected, powerful Excitants, ginger, capsicum, ammonia, and the most pungent aromatics, are indicated. In atony, also, of the intestinal canal producing obstinate constipation, when ordinary purgatives are of little avail, the addition of Excitants, by rousing the nervous energy, is productive of the best effects.

In the administration of Excitants of any kind in gastric and intestinal diseases, it is important to ascertain the exact condition of the stomach, as well as that of the whole mucous membrane of the intestinal canal. Before prescribing Excitants, we must be satisfied that there exist no ulcerations, nor schirrous nor cancerous tendency in any portion of the canal. It is necessary also to determine whether vomitings

or gripings, which may seem to demand their employment, be not symptomatic of cerebral engorgements, or irritations of the encephalon or of the spinal marrow: at the same time, the condition of the liver and the neighbouring organs, the pancreas and the spleen, must be carefully investigated.

It is scarcely necessary to caution against the general employment of Excitants in febrile states of the habit marked by a quick and full pulse, with much heat of body: in truth, it is only in the latter stage of fevers, when the diminished action of the heart is manifested by a fluttering pulse and a cold clamminess on the skin, that Excitants are called for or are admissible: they rouse again not only the nervous energy, but also that action of the capillary system without which the powers of life cannot be sustained. But much discrimination is requisite in determining the exact period when Excitants are demanded, even in this stage of fever; and I am decidedly of opinion that there is less risk in permitting the prostration of strength to proceed for a short time, than to risk the administration of Excitants on the first indications of the approach of collapse. I have already detailed the circumstances which demand the employment of wine in typhus; but, even when these are fully developed, much caution is requisite. When the debility seems to yield to the free administration of wine, the observing physician will often find sufficient reasons for suspecting that the temporary vigour which it appears to bestow is likely to be succeeded by a greater degree of debility, and consequently that the utmost danger may result from persevering in the use of Excitants. When petechiæ appear, or when there is protracted diarrhœa followed by sudden collapse, wine and other Excitants are not only admissible, but are the only remedies upon which we can rely for the safety of the patient; and this is also true when the tongue is coated with a brown fur, the teeth and gums are covered with sordes, the skin is hot and dry, and when subsultus tendinum and low delirium are present, with pain in the head, and a rapid, small, thrilling pulse.

The topical influence of Excitants has been found beneficial in that debility of the organs of the glottis which reduces the voice to a whisper. In affections of the chest, also, ac-

accompanied with spasm, as in the latter stages of whooping cough, their utility is undoubted. In softening of the muscular tissue of the heart, they prove servicable in renewing the vigour of the ventricular action and rendering the contractions more steady and regular.

Excitants, however, are not only contraindicated, but are directly injurious, wherever there is reason for suspecting hypertrophy of one or both ventricles of the heart. When the hypertrophy is confined to the left ventricle, the administration of Excitants is followed by vertigo, dimness of sight, singing in the ears, weight in the head, and epistaxis, or, if this do not occur, by congestion of the encephalon and apoplexy; and certainly this class of medicines is equally improper in inflammatory states of the coats of either the arteries or the veins; or in palpitations indicating inflammatory action either in the pericardium or in the heart. In bronchitis and similar affections of the chest, although, during the continuance of the inflammatory action, when the cough is dry and the expectoration difficult, Excitants would be productive of the greatest mischief, yet in the advanced stages of pulmonary affections, particularly in peripneumony, their administration is demanded not only to aid expectoration, but to stimulate the capillaries so as to relieve the engorged state of the pulmonary tissues. On the same principles also camphor and sulphuric ether prove successful in relieving the urgent symptoms in some varieties of dyspnoea, whilst they are as injurious in others. It is in those cases in which matters are effused into the air-tubes, consisting of either a redundancy of the natural secretion, or frothy mucus, the result of previous inflammation, that we may most confidently anticipate advantage from the administration of Excitants.

In the neuroses Excitants are clearly indicated; for example, in hysteria, epilepsy, chorea, catalepsy, tetanus, neuralgia, and, under some circumstances, in hypochondriacal and maniacal affections. In this general statement, however, many exceptions are included: the state of the brain and the spinal marrow must be clearly ascertained; morbid dissections having demonstrated that many of those affections which are frequently regarded as altogether nervous, have been con-

nected with and are dependent upon abscess, ulcerations, tumours, or depositions of blood in the substance of the brain, or collections of fluid in the ventricles; sometimes on similar affection of the spinal marrow or its tunics. Wherever these are suspected, there can be only one opinion respecting the impropriety of the administration of Excitants.

In many instances of paralysis, especially those of the lower extremities, constituting paraplegia, experience has fully demonstrated the utility of strychnia and other Excitants; but at the same time many circumstances may exist which contraindicate their employment, and nothing is more necessary than a sound judgment and a cautious diagnosis in such cases. Indeed, in all cases of palsy a more indiscriminate employment of Excitants has been indulged in than a correct knowledge of the pathology of the disease warrants, even after all pressure upon the brain has been removed. External Excitants, however, are less exceptionable; but the result of their employment, not excepting electricity, has been disappointment.

From the state of the nervous centres closely resembling those which produce paralysis, the skin often loses its natural qualities, becomes pale or discoloured, soft and scaly, or covered with crusts. In this condition, Excitants prove serviceable, by throwing the blood upon the surface and exciting generally the cutaneous capillaries. It is essential, however, to distinguish between this state and that in which inflammatory pustules and tubercles appear upon the skin, and the disposition to which is undoubtedly increased by exciting medicines; while darting pains, restlessness, and wakefulness, supervene and increase all the sufferings of the patient.

In many painful affections, in which it is necessary to exhaust the sensibility of nerves, the topical application of Excitants has been found beneficial; as, for example, in toothache from caries, which is relieved by the introduction of any acrid substance, as camphor or volatile oil, into the hollow of the tooth. On similar principles, the use of local Excitants is indicated in other affections in which pain is a predominant symptom; for example whitlow, paronychia, in which lotions of alcohol have been found useful; the various species of cry-

thema, and in some of those of herpes. In malignant sore throat, capsicum and some other Excitants form the bases of the most useful gargles.

From the details which have been delivered respecting the influence of the substances arranged in this class of medicines, the importance of Excitants, in a therapeutical point of view, is undoubted; but the very nature of many substances belonging to the class renders them more liable to be abused than those in any of the other classes. Many Excitants are employed as condiments; some of them as our daily beverage; and enough has been said with respect to the general predilection of all nations for diffusible Excitants, particularly wine and ardent spirits, to demonstrate the caution which is requisite in their employment as remedial agents. It is of the utmost importance that the student and the inexperienced practitioner should clearly understand the distinction between Excitants and Tonics, or those medicines which simply increase action and those which are capable of producing a permanent increase of power. It is true that the stimulus which Excitants afford to the nervous system, in a debilitated state of the body, give a temporary impulse to the power of the digestive organs and consequent increase of strength to every part of the frame; but this effect is merely temporary: and the continued employment of the stimulant, instead of maintaining this improved condition of the habit, is soon followed by the directly opposite state, that of exhaustion; indubitably proving that action is not strength. The combination, however, of Excitants and Tonics, as I shall have occasion to shew in its proper place, aids greatly the power of the latter; calling forth, as it were, the strength which the tonics render permanent.

SECTION III.

SEDATIVES.—MEDICAMENTA SEDANTIA*.

Sedatives are substances which directly depress the energy of the nervous system, diminishing motion in animal bodies

* From the Latin word *sedo*, to calm.

without inducing previous excitement. Regarded in a remedial point of view, they are powers intended to diminish preternaturally increased action in animal bodies. This increased action may display itself chiefly in the circulating system, and only in the nervous system as it is connected with the sanguiferous; or it may appear in the muscular system, and may affect the sanguiferous only in a secondary and transitory manner. Whatever may be the cause of this increased action, whether irritating matters introduced into the body, or some state of its own œconomy, the substances which directly lessen this preternatural action may be considered as Sedatives; and this they effect by depressing the nervous power, and by diminishing the energy of the brain and that of the spinal marrow.

The immediate influence of the administration of a Sedative is experienced first upon the nervous system, and secondly through it upon the muscular: if the dose be large, the individual who has taken it loses his power of volition, becomes vertiginous and staggers; the nerves of sensation cease to respond to ordinary impressions, syncope supervenes, and, in a few seconds, life ceases.

In general, writers on the *Materia Medica* have confounded Sedatives with Narcotics; from which, however, they are perfectly distinct. Dr. Young, in his *Table of Classification*, has properly separated them; and Dr. Billing* has also attempted to mark out the boundaries which distinguish these two classes of medicines. Let us examine in what this distinction consists.

The administration of narcotics is frequently followed by sedative or depressing effects; but, in every instance, this is the result of a previous excitement, which is more or less obvious in proportion to the extent of the dose. In small and moderate doses, narcotics augment the force and increase the frequency of the pulse, promote the secretions, and bestow a temporary higher degree of vigour both to the body and to the mind. In a short time afterwards, however, the transitory nature of this state of excitement is conspicu-

* *First Principles of Medicine*, p. 44.

ous; and one of depression or collapse follows, in which general languor, dulness of sensibility, and sleep, ensue. When the dose is large, the period of the excitement is so short, that the symptoms of diminished sensibility and motion appear as if they were induced without any previous increased action. This seems to throw difficulties in the way of separating Sedatives from Narcotics; but, if I can demonstrate that, even in small doses, there is no excitement of the system from the administration of those medicines which I term *Sedatives*, there will be little difficulty in proving that their operation is perfectly distinct from that of Narcotics. To illustrate this point by an example, let us suppose that a few drops of a powerful sedative, hydrocyanic acid for example, are taken into the stomach: no quickening of the arterial action can be perceived; on the contrary, the force and the frequency of the pulse are diminished, and there is a feeling of depression which is too decided to be overlooked: it is, indeed, evident that the acid possesses a quality directly the opposite of that of an excitant; it produces a prompt but decisive effect on the nervous system, not only directly diminishing its sensibility, but, if the dose be sufficiently large, also paralysing the whole powers of the sensorium commune. I am perfectly aware that Majendie and others regard the first effect of hydrocyanic acid as one of transient excitement, followed by an immediate contrary state: but my own experience, and the results of many experiments on living animals, are adverse to this supposition; and, to say the least of the opinion of this justly distinguished physiologist, it is purely hypothetical. This directly depressing power is not confined to hydrocyanic acid: the other substances which I shall arrange in this class operate in a similar manner: the general symptoms are an immediate diminution of the powers of life, prostration of strength, stupor, and numbness, lowness of the animal spirits, yawning, sleepiness, vertigo, and indeed a complete paralysis of the natural powers of the habit: yet, in the midst of all, the muscular energy is scarcely diminished, and some of the automatic actions proceed, for a short time, when every symptom of sensibility to impression is utterly destroyed.

The admirable experiments of Mr. Brodie upon sedative

poisons explains well the manner in which this state is produced. Sedatives act upon the brain through the medium of the nerves, the functions of which are consequently more or less impaired; but it is upon the nerves of sensation chiefly that direct sedatives act; and, therefore, as the motor nerves are but little affected, the organs of respiration continue their functions; and the powers of the heart also being unimpaired, that organ continues to act, circulating venous blood for some time, as long as respiration can be supported. Thence, in Mr. Brodie's experiments, by maintaining artificial respiration, so as to carry off the superfluous carbon from the blood, it sometimes happened that the animals recovered. It is easy to demonstrate that the action of the heart and the peristaltic movement of the intestines continue after the sensitive life of the animal is destroyed. When Sedatives taken into the body do not destroy life, their operation is lessened after a certain time; and sooner or later, according to circumstances, it altogether terminates. When the sedative operation does not prove mortal, the impression may be renewed by a reapplication of the means; but it becomes weaker after each repetition until it almost ceases to act, unless the dose be greatly augmented. It is difficult to explain this fact.

If these statements be correct—and that they are so is undoubted—one inference only can be drawn from them:—that sedatives act directly on the nerves of sensation, producing a peculiar effect on those parts of the system which are supplied with these nerves; and that this effect is most probably not the result of a stimulus rapidly exhausting the excitability, but of a direct impression of a peculiar kind on the nerves, which immediately exhausts them of their susceptibility of receiving impressions from external objects. From the ideas which we obtain, at a very early period of life, of the effect of stimulants as connected with mechanical impressions, it is much less difficult for us to admit the hypothesis, that, in every instance of diminished action from the influence of medicines, there must exist a previous state of excitement, than that something is either abstracted from the nervous energy, or that some alteration takes place in the nerves themselves, which diminishes their power of receiving impressions. It is

true that no examination of the nerves in animals killed by sedative poisons has demonstrated any change in these organs; and we are necessarily unable to affirm, from appearances, that any thing is either abstracted from them, or that their state is in any degree altered: yet it is evident that some change has taken place, and that there has been a complete exhaustion of that power, their excitability, which renders the nerves susceptible of impressions. Thus far we know: but in every other respect the question remains as we found it. We may, however, presume to affirm that the sedative effect is immediate, not secondary. Sedatives diminish or destroy excitability, according to the extent of the dose in which they are given; and, as the secondary effect of their direct influence on the nervous system, they lessen, both in point of strength and frequency, the action of the heart and arteries on the pulse, or extinguish it altogether.

Notwithstanding the powerful action of Sedatives, their effects in small doses are, in a certain degree, confined to the part to which they are applied: in larger but still moderate doses, their influence is extended over the system; and it is only in comparatively large doses that they display their poisonous properties, so rapidly destructive of life. In this respect, Sedatives differ from many of the other classes of medicines; their effects being regulated more by the extent of the dose than by the state of the body.

1. *Effects of Sedatives on the Digestive Organs.*—When a sedative substance is introduced into the stomach, in a moderate dose, no particular sensation is experienced; and the certainty that it has operated upon the organ is rendered obvious rather by the effect upon the digestive function which follows, than by any thing which can be referred to the state of the stomach itself.

When the stomach is morbidly irritable, this diseased state is more or less maintained by the imperfect secretion of the viscus reacting upon its nerves, in a condition which renders them too susceptible of even ordinary impressions: the influence of a direct sedative, therefore, when admitted into the organ produces an immediate effect upon the gastric nerves, not only rendering them less susceptible of impression, but,

by removing the irritation which is present, favouring the formation of a more healthy, because more slowly secreted, gastric juice, and thus also removing one exciting cause of the diseased condition of the organ. That such a local influence may be exerted upon certain sets of nerves, without being sensibly felt by the general system is undoubted; and I shall have ample opportunity of proving the truth of this assertion when treating of the action of Hydrocyanic Acid.

If the dose of the Sedative be a little increased, the effect is then extended to the brain, and manifested by slight vertigo, insensibility for a few seconds, sinking of the pulse, failing of the limbs, which the patient most commonly refers to the thighs, general lassitude of the frame, and torpor of the mind. If the dose be large, but not sufficient to operate as a poison, a sensation of weight and dull pain, felt in the forehead and in the bottom of the orbits, is superadded. It has been contended that the last-mentioned symptom indicates the existence of excitement previous to the state of collapse which I have described; but this opinion is not tenable, as it is well known that coma may proceed from inanition, as well as from congestion in the brain, and that the administration of stimulants may be requisite for the relief of symptoms closely resembling those which are cured by venæsection and depleting remedies. This fact, which I had observed and acted upon many years ago, was first made known to the profession by my friend, Dr. Marshall Hall*; and Dr. Abercromby†, nearly about the same time, and afterwards by Dr. Gooch‡; and it is now generally acknowledged to be founded upon correct observation.

2. *On the Circulating and Respiratory Organs.*—When the influence of Sedatives extends beyond the stomach, or the surface to which they are applied, it is frequently displayed on the heart and arteries, by a state of diminished action: but this is by no means commensurate with the impression made upon the nervous system. When death occurs, the arteries and the left ventricle of the heart are found

* Researches in the Effects of Loss of Blood, page 119.

† Account of some Diseases peculiar to Women.

‡ Researches on Diseases of the Brain and Spinal Cord.

empty, the right gorged with black blood. Schubarth asserts that the heart loses its contractility; but my own experience, and observations drawn from experiments upon the lower animals, incline me to accord with Coullon*, that the heart, the intestines, and the voluntary muscles, retain their contractility in poisoning by hydrocyanic acid, at least when the medicinal acid is that which is used; and that this is true also with reference to other Sedatives.

The effects of Sedatives on the respiratory organs depends much on the manner of employing them, whether they be applied directly to the lungs in a gaseous form, or operate through the medium of the stomach. If pure carburetted hydrogen gas be breathed, an immediate sensation of numbness in the respiratory muscles, and an overpowering oppression of the chest, are felt; in a few seconds the person becomes insensible to external objects; he feels "sinking into annihilation†;" and if he continue breathing the gas, he dies with a complete destruction of muscular irritability. On examining the lungs, no signs of increased action can be perceived; the organs appear as if their functions had been instantaneously arrested; the blood is fluid and dark coloured; and things remain as one may suppose them to have been at the moment when the cessation of action occurred.

3. *On the Secerning System.*—Little is known respecting the influence of this class of medicines on the discerning system, except what we have stated of its effects on the secreting surface of the stomach. In some instances, salivation has occasionally followed the employment of hydrocyanic acid‡; and, in other instances, the secretion of urine has been greatly augmented. The latter effect seems to depend on the same circumstances which augment the urinary discharge, when fear and some other mental sedatives influence the habit.

4. *On the Nervous System.*—From what has already been stated, there can be no doubt that it is on the nerves that sedatives exert their influence. This is further proved by the fact, that when hydrocyanic acid is applied to one limb only of a frog,

* Recherches, &c. p. 146.

† Researches on Nitric Oxide Gas, p. 467.

‡ Lond. Med. Journ. Feb. 1823, p. 128.

this member becomes paralyzed, whilst the other limbs remain unaffected. Robiquet, also, while making some experiments on the tension of the vapour of this acid, after having exposed his fingers to it for some time, felt a numbness in them, "which lasted several days*," without experiencing any effect from the acid on his system. In cases of poisoning by sedatives, however, nothing, either in the brain, the spinal marrow, or the nerves, afford any information of the nature of the impression, except that it is not that of excitement: indeed, this conclusion might have been anticipated from their effects—exhaustion of excitability and death—without one preceding trace of increased action when administered in large doses†. Whatever may be the nature of the impression, it is evident that it is different from that of any exciting power, whether the sedative be of a corporeal or mental nature.

The foregoing considerations, although they afford little which is satisfactory for enabling us to form any accurate conclusion as to the manner in which this class of medicines influence the animal organs, yet they confirm the truth of the proposition, that there are powers which destroy excitability and life without previous excitement, or, at least, without any signs of it being discoverable.

Sedatives, from the nature of their effects, may be arranged under two distinct heads: *Direct Sedatives*, or those which operate immediately on the nerves: and *Indirect Sedatives*, or those which operate through the medium of the vascular system.

* Journ. Complement. v. xxviii, p. 33.

† Christison on Poisons, 1st edit p. 561.

TABLE OF SEDATIVES.

A. DIRECT SEDATIVES.

* *Organic Products.*

a.—CYANOGEN—

Combined with Hydrogen, in
Hydrocyanic Acid.

Laurel Water.

Volatile oil of Bitter Almonds.

Combined with Potassium, in
Cyanide of Potassium.

b.—EMPYREUMATIC VOLATILE OIL—in
Tobacco smoke.c.—NICOTINA—contained in the leaves of
Nicotiana Tabacum. 5. 1. Solaneæ.* * *Inorganic Substances.*

d.—SULPHUR—

Combined with Hydrogen, in
Sulphuretted Hydrogen Gas.
Hydrosulphuret of Ammonia.

e.—CARBON—

Combined with Hydrogen, in
Carburetted Hydrogen Gas.

B. INDIRECT SEDATIVES.

f.—CARBON—

Combined with Oxygen, in
Carbonic Acid Gas.

g.—BLOOD-LETTING.

ORGANIC VEGETABLE PRODUCTS WHICH
OPERATE AS SEDATIVES.

CYANOGEN.—The first of the Organic Products is Cyano-
gen. This substance, which forms the active constituent of
several powerful sedative medicines, has been already de-
scribed. Cyanogen is obtained, in the gaseous state, from
Bicyanide of Mercury, by the aid of heat. The mercury is

disengaged from the Cyanogen, and volatilized in a metallic state, whilst the Cyanogen is procured in the gaseous form, and may be collected in jars, over mercury. To procure it in this manner, the bicianide should be perfectly dry.

1. *Cyanogen with Hydrogen.*

Cyanogen, in combination with Hydrogen, forms an acid which possesses very peculiar properties on the living animal system.

a. Hydrocyanic Acid.*—This acid is formed in several processes in which both animal and vegetable matters that do not naturally contain it are employed. It is found prepared by the hand of Nature in the leaves of the cherry laurel and those of the peach; in the blossoms and seeds of the peach, the apricot, the bitter almond, the cherry laurel, the cluster cherry, and of several other plants. The essential oil and the distilled water of these vegetable substances yield hydrocyanic acid; but it has been doubted whether the acid be ready formed in these substances, or whether it be not the result of the operation for procuring it, by a new combination of its ultimate constituents, carbon, nitrogen, and hydrogen.

Hydrocyanic acid is artificially prepared for medicinal use; but in this state it is diluted with water, and so far it differs from the real acid. There are, therefore, two descriptions of hydrocyanic acid, the strong and the medicinal. Various processes have been proposed for procuring both of them. Vauquelin's process is the best for the strong acid; that of Scheele, modified, for the medicinal preparation. To procure the strong acid, the dry bicianide, broken into small particles, is put into a tube about eighteen inches long, and less than half an inch in diameter. One end of this tube is connected with a flask, in which sulphuretted hydrogen gas is to be evolved and passed through the tube until the whole of the bicianide become black. The flask is to be

* The names Cyanogen and Hydrocyanic acid were imposed by Gay-Lussac; the former implies a *producer of blue*, being a compound of two Greek words, ξανός and γενναω; and, therefore, as this is acidified by hydrogen, he called the acid Hydrocyanic.

then removed, and one end of the tube closed with a little plaster of Paris, whilst the other is to be attached to a small flask placed in ice. As soon as the plaster is set, the tube is to be gently heated to drive off the hydrocyanic acid, which is to be received in the cooled receiver. Let us examine in what manner the hydrocyanic acid is formed in this process. Its components are cyanogen and hydrogen: now, the bicianide consists of 2 prop. of Cyanogen = 52, and 1 prop. of Mercury = 200: the composition of sulphuretted hydrogen is 2 prop. of Hydrogen = 2, and 2 of Sulphur = 32. On passing the sulphuretted hydrogen over the bicianide, the two prop. of hydrogen which it contains combine with the two of cyanogen of the bicianide, and form hydrocyanic acid, whilst the two prop. of sulphur combine with the one prop. of the mercury, and form a bisulphuret of mercury.

The hydrocyanic acid, thus prepared, is a colourless, limpid fluid, with a penetrating odour, which causes severe headache, nausea, and fainting, when it is incautiously snuffed up the nostrils. This odour is generally compared to that of the peach blossom or the bitter almond; but this error has been fallen into from the odour of the acid being combined with that of the volatile oil of those vegetable substances which contain hydrocyanic acid. The odour of the free acid certainly differs from that of the peach kernel. This acid has a cool taste at first, but it soon becomes hot and irritating: it evaporates so rapidly that a drop of it congeals by the cold caused by the evaporation of a part of it: it combines with water and alcohol in all proportions, and faintly reddens litmus. This strong acid has a specific gravity of 0.7508; it boils at 80° , and freezes at 5° ; its vapour is inflammable, burning with a blue flame; and, when mixed with oxygen gas, it detonates, and leaves *carbonic acid*, *nitrogen gas*, and *water*. This strong acid is so susceptible of decomposition, that it sometimes spoils within an hour after it is made. It is converted, by decomposition, into ammonia, and a carbonaceous matter of a black colour, which contains carbon and nitrogen. This strong acid is not used in medicine.

The medicinal acid is also procured in several ways. One very simple method is to pass a stream of sulphuretted hy-

drogen gas through a solution of bichloride of mercury until no more sulphuret of mercury is precipitated, or until the filtered fluid remains colourless and transparent, when mixed with a solution of sulphuretted hydrogen. The clear solution is then to be decanted and agitated with carbonate of lead, to remove any excess of sulphuretted hydrogen, and afterwards filtered. In this process the bichloride is decomposed; the cyanogen, which is set free, unites with the hydrogen of the sulphuretted hydrogen gas, forming hydrocyanic acid, whilst the sulphur combines with the mercury, and forms a sulphuret of that metal, which precipitates, and is thus easily separated. An acid of any given strength may be thus prepared.

The Dublin College orders hydrocyanic acid to be prepared by mixing one ounce of cyanuret of mercury with seven fluid drams of muriatic acid, diluted with eight fluid ounces of water. Of this mixture, put into a retort, eight fluid ounces are to be distilled into a cool receiver. The products are hydrocyanic acid, obtained in the receiver, and a solution of corrosive sublimate, which remains in the retort. The chief recommendation of this process is its economy: but, if too much muriatic acid be employed, the result will be a very small proportion only of hydrocyanic acid, a chloride of ammonia and mercury, and formic acid. But the best preparation for medicinal use, is that of Scheele, modified. One part of Prussian blue, and half the quantity, by weight, of red oxide of mercury, are reduced to fine powder and boiled in a glass vessel, with twenty parts of distilled water, agitating the mixture during the whole time with a wooden spathula. This mixture is then allowed to remain a short time at rest, after which the whole is filtered, and the deposit washed on the filter with boiling distilled water. The filtered fluids are next to be put into a flask with $\frac{3}{4}$ of fine popyrized iron filings, and $\frac{1}{2}$ of strong sulphuric acid. Having agitated this mixture well, and allowed it to remain at rest for an hour, the supernatant fluid is to be distilled in a retort until $\frac{1}{6}$ of the whole passes over. This is diluted hydrocyanic acid, which only requires to be purified from any sulphuric acid that may have come over with it, by means

of barytic water and redistillation over a little pure chalk. Processes to procure this acid have been also proposed by Vauquelin, Gay-Lussac, Robiquet, Pessinau, Frantwan, and others; but this process of Scheele affords an acid of an uniform strength, well adapted for medicinal use. It is $\frac{1}{6}$ of the strength of the strong acid.

In this process the Prussian blue, which contains hydrocyanic acid and peroxide of iron, is decomposed by the peroxide of mercury, and a solution of bicyanide of mercury is formed, which is next decomposed by the hydrogen gas produced from the action of the iron filings and the sulphuric acid on the water; the hydrogen thus evolved, uniting with the cyanogen of the bicyanide, forms hydrocyanic acid. It differs from the strong acid only in strength. Its specific gravity should be 0.995. As it is of consequence to have an acid for medicinal purposes always of the same strength, Dr. Ure has proposed a test for ascertaining this point. He agitates peroxide of mercury, reduced to a fine powder, in the acid to be tried, until no more be dissolved. On dividing the weight of the peroxide used by four, the quotient expresses the quantity of real acid contained in the diluted acid. No heat must be employed; and the oxide should be added to the acid in small quantities at a time, so as not to be in excess, which is known by the solution not changing the infusion of red cabbage to green.

According to Gay-Lussac, the composition of pure hydrocyanic acid in numbers is, Carbon 44.39, + Nitrogen 51.71, + Hydrogen 3.90 = 100; or 1 prop. of Cyanogen = 26, + 1 prop. of Hydrogen = 1, making the equivalent of the acid 27. Hydrocyanic acid is decomposed by chlorine and the oxides of antimony. It is precipitated from its solutions by nitrate of silver and sulphate of copper, but not by the salts of iron, nor the alkaline sulphurets and hydrosulphurets. If it be not preserved in well-stopped bottles, it becomes weak by the volatilization of the acid; it also, sometimes, undergoes decomposition, and deposits brown flakes, in which state it is unfit for medicinal use.

Such is hydrocyanic acid in its strong and its diluted state.

Before examining its therapeutical properties, let us examine its natural compounds. The first of these is—

b. Laurel Water.—This is the distilled water of a plant which is not, properly speaking, a laurel, but a species of cherry, the *Prunus Laurocerasus* of Linnæus, a native of the coast of the Black Sea, although it is now very common in Europe, into which it was brought about the end of the sixteenth century. It belongs to the natural order *Amygdalææ**. It is now perfectly naturalized to our climate; and the beauty of the leaves and the agreeable odour of the flowers and of the whole of the plant have obtained for it a place in every garden. The volatile oil contains the hydrocyanic acid, which resides chiefly in the leaves and kernels of the fruit.

The flowers, as well as the leaves, have the taste of the bitter almond and the kernel of the peach, and communicate it readily to boiling milk, cream, diluted alcohol, and other substances; and in this form they are employed as condiments and for making ratifia; customs that have been productive of fatal consequences. This distilled water, besides the grateful odour of the peach kernel, exhales also the peculiar odour of hydrocyanic acid, which can be easily distinguished from the former. According to Schubarth, it contains 0.25 per cent. of hydrocyanic acid; but, although tests readily detect the acid, yet I am inclined to think that its proportion is overrated.

The leaves and kernels of another species of cherry, the cluster cherry, *Prunus Padus*, an indigenous species, yields also by distillation a water strongly impregnated with hydrocyanic acid. It is from the fruit of this species of cherry that the Swiss and the Germans distil a spirit which they call Kirschwasser. Several other species of the genus *Prunus* yield a similar distilled water; as, for instance, the black or bird cherry, *Prunus Avium*; the *sloe*, *Prunus spinosa*; the *Bullace*, *Prunus insititia*, and even the leaves and kernels of the common cherry, *Prunus Cerasus*: but in these both the oil and the hydrocyanic acid are in much smaller quantity than in the *P. lauro cerasus*.

* Woodville's Med. Bot. 3rd edit. p. 513, pl. 185.

c. *Oil of Bitter Almonds*.—The seed yielding the largest quantity of combined hydrocyanic acid is the bitter almond; the kernel of the fruit of the variety *amarus* of the *Amygdalus communis*, a tree which is a native of Barbary and Syria, but is now cultivated in almost every part of Europe*. The sweet and the bitter almond are produced on trees so closely resembling one another, that they are regarded as varieties of the same species; and it is asserted that the sweet almond tree yields bitter almonds when neglected, the bitter almond tree sweet almonds when it is cultivated with care†; but I am rather sceptical on this point. When the marc, which remains after bitter almonds have been subjected to the press, is distilled, a pale yellow volatile oil is obtained, very acrid and bitter to the taste, exhaling the odour of the peach blossom, and of a greater specific gravity than water. It is distinguished from other volatile oils by the promptitude with which it absorbs oxygen, and the formation of needle-form crystals, which are benzoic acid and the result of this oxygenation‡.

The poisonous influence of the oil of bitter almonds was known so early as the time of Dioscorides, who states that it was employed for killing wolves; but it was not known, until a German chemist, Bohm, ascertained the fact, that this influence depends on the presence of hydrocyanic acid. The fact that this oil contains hydrocyanic acid is easily proved, both by tests and also by digesting it with peroxide of mercury, which is converted into bityanide of mercury. Vogel thinks, and probably correctly, that the volatile oil is poisonous, independent of the hydrocyanic acid; for when this is separated from it by distillation, the oil is still poisonous: but Robiquet has quaintly remarked, that probably the oil tried by Vogel was not completely freed from the acid. When this oil is distilled, the portion which comes over has less of the odour of the peach blossom, but considerably more of that of hydrocyanic acid than the oil itself; whilst the residue in the retort, which has acquired a high red colour, scarcely smells of hydro-

* Woodville's Med. Bot. 3rd edit. p. 507, pl. 183.

† Murray's Apparatus Medicaminum, vol. iii, p. 257.

‡ Ann. de Chimie et de Phys. tome xliv, p. 378.

cyanic acid, but retains much of the odour of the entire oil. From these experiments, the oil of bitter almonds appears to consist of two distinct substances: the one an azotized portion, which, being highly volatile, passes first over when the distillation is conducted with a gentle heat, and is highly impregnated with hydrocyanic acid; the other a crystallizable portion, which passes over last, and crystallizes on exposure to the air; but which, contrary to the opinion of Vogel, does not regain the odour of the bitter almonds when it is treated with hydrosulphate of ammonia, provided the crystals be perfectly freed from the volatile oil. These crystals acquire acid properties when exposed to the air: they are soluble in boiling water, and they crystallize on cooling; they are fusible, volatile, unite with alkalis, are not poisonous, and, in fact, present no analogy with the oil from which it is procured.

Robiquet supposes that the volatile oil of bitter almonds does not exist naturally in the almond, which he contends possesses a peculiar principle that appears to him to be the sole cause of its bitterness, and one of the constituent elements of the volatile oil, for the formation of which the presence of water is essential. According to the experiments of MM. Henry and Plisson, the constituents of the oil of bitter almonds are of carbon 74.40, + oxygen 11.79, + nitrogen 5.97 parts. The water with which the oil is distilled retains a portion of the hydrocyanic acid and the odorous portion of the oil in solution, and consequently possesses powerful sedative properties.

We have now to consider, physiologically, the action of hydrocyanic acid on the animal economy. The powerful and baneful effects of bitter almonds were observed at a very early period. The most remarkable instance of poisoning by laurel water on record is that of Dr. Price, the Alchemist, who, in 1782, poisoned himself with laurel water a few days before the time appointed for repeating his experiments of converting mercury into gold*. In the cases of poisoning by this distilled water, it was remarked by Cullen, as a curious fact, that, however violent its operation, no traces of inflam-

* For an account of the earliest proof of the deleterious effects of laurel water, see *Phil. Trans.* vol. xxxvii, p. 84.

mation were ever detected after death: but it was not until after the discovery of hydrocyanic acid, when this agent was ascertained by Bohm to be the active principle in laurel water, that the cause of this was fully understood.

Hydrocyanic acid, in its anhydrous or concentrated state, is so powerful a poison, that a single drop, or at most two drops of it, introduced into the stomach of a dog, or injected into the jugular vein, or even applied to the eye, will destroy the animal as instantaneously as the most powerful shock of an electrical battery, or the stroke of lightning. This rapidity of action is incompatible with the idea that it must be taken into the circulation before it can exert its sedative influence. It exerts its influence directly on the nervous sensibility, which it completely extinguishes; and in smaller animals this is effected by the vapour, even when it is largely diluted with atmospherical air. The usual symptoms in cases of poisoning by the weak or medicinal acid are stupor and numbness, with a sense of weight at the top of the head; yawning, irresistible drowsiness, vertigo, and dimness of sight; the pulse, which is at first not affected, quickly flags and becomes slow and vibrating; but before this takes place, vomiting and hiccup sometimes occur, the extremities are paralyzed, the pupils remain dilated, and every function seems destroyed, except respiration, which is rarely either accelerated or difficult. Its effects on the human body have too often been witnessed. In a case mentioned by Hufeland, a strong and healthy man, who was seized as a thief by the police, whilst in the act of being conveyed to prison, took a small phial from his pocket, broke off the neck of it, and swallowed the contents. He staggered a few paces, then fell on his knees, and instantly expired without a struggle. It affects all animals indiscriminately, from the worm up to man: all are killed by large doses of it, and all die nearly in the same manner. An instantaneous cessation of vitality takes place; yet the eyes are open and appear animated as if alive. Although the sensibility is thus so completely destroyed that nothing can again rouse it into activity, yet, if in this state the body be opened, the action of the heart is seen proceeding, and the most beautiful demonstration is afforded of the

vermicular and annular motion of the intestinal canal ; demonstrating, as Majendie has happily expressed himself, that an animal may be dead with regard to its external functions, although still enjoying life through its nutritive faculties.

Hydrocyanic acid, therefore, whether in a free state or combined with volatile oil, as in that of the bitter almond and in laurel water, is a most powerful sedative poison.

The post-mortem examination of the body exhibits the blood congested in the right ventricle of the heart and the veins. The blood appears to be more than usually fluid, and sometimes exhales an odour of hydrocyanic acid. The venous turgescence extends to the brain and spinal marrow. The same appearances are found when the poison is the essential oil of bitter almonds or is laurel-water.

With respect to the period of time in which this acid produces its fatal effects, I have seen it destroy a dog before it could be put upon the ground from the knee of the person who held him during the administration of the poison. In some experiments made by Mr. Macaulay, of Leicester, one dog to which four drams of the diluted acid were given died in eight seconds ; another, with four drams, in seven seconds ; and another, four drams and a half, in three seconds. In these cases, it is scarcely requisite to say that absorption could not have taken place. It would, however, be uncandid not to mention the experiments of Dr. Krimer, of Aix la Chapelle, which are intended to prove that, notwithstanding the rapidity with which Hydrocyanic Acid destroys life, it may, nevertheless, be taken into the circulation. He found that it does not act when it is applied directly to the medullary matter of nerves ; nor when it is applied externally to the brain and spinal marrow. He even states that he has ascertained that, when applied to the tongue, it does not kill until it is evaporated by the heat of the organ, and, as he suspects, is absorbed into the pulmonary circulation, when it kills by first diminishing the action of the heart and then that of the spinal marrow. He says that, when the arteries and veins of a part are tied, and the nerves left entire, and the acid is introduced into a wound, it does not act, but it takes effect the moment the ligatures are removed from the

blood-vessels; and that death also occurs when the nerves are divided, if no ligatures be put on the blood-vessels. When all the vessels of the stomach are tied, although the nerves remain entire, Hydrocyanic Acid, when introduced into the viscus, does not produce its usual effects. But it operates immediately when it is placed on the tongue; and, in thirty-six minutes, it can be detected in the blood by reagents; which is also the case when it is inhaled without the vapours coming in contact with the nerves of the tongue. These experiments of Dr. Krimer are, *prima facie*, apparently confirmed by those of Mr. Brodie with oil of bitter almonds. A single drop was applied to the tongue of a cat; she was instantly seized with violent convulsions, and then lay on one side, motionless, insensible, and breathing in a hurried manner. The respiration, however, became more and more obstructed; and the animal died in five minutes. On opening the thorax, the heart was found pulsating eighty beats in a minute, and circulating dark blood. But the same effects resulted from injecting two drops of the oil, in half an ounce of water, into the rectum of the animal; so that no weight can be attached to the first experiment as far as it relates to Dr. Krimer's theory.

Notwithstanding, therefore, the conclusiveness of Dr. Krimer's experiments, I am by no means satisfied of the justness of the conclusions that have been drawn from them. I cannot conceive how it is possible that the acid can be taken into the pulmonary system and yet not act on the nerves: besides, in this case, an assumption is made regarding the pulmonary absorption which requires to be proved. On these accounts, and from witnessing, as I have done, the instantaneous effects of this poison when given in large doses, I see no reason for altering my opinion respecting the manner in which it acts on the animal economy.

The same reasoning refers to Cherry Laurel water. Some experiments have lately been made with it by M. Jorg and some other physicians, at Leipsig. They took it in doses progressively increased from five to twenty-five minims, and finally to a hundred and twelve minims. The symptoms were those of concentrated action on the brain, sense of

weight on the head, sleepiness, torpor of the intellectual functions, lassitude and feebleness, retardation of the pulse, and headache. This last symptom was preceded by a dull, pungent pain in the head, chiefly in the region of the optic nerves. It likewise brought on a slight attack resembling bronchitis. M. Jorg refers these symptoms to the turgescence or plethora of the vessels of the brain; but they may arise from paralysis of the organ.

2. *Cyanogen with a Metallic Base.*

d. Cyanide of Potassium.—This substance does not hold a place in any of the British Pharmacopœias; but, as it possesses the same sedative properties as free hydrocyanic acid, as it is always the same, and is not liable to spontaneous decomposition, it might be advantageously employed instead of hydrocyanic acid as a remedial agent—an idea which has been suggested by MM. Villermé and Robiquet. It is prepared by exposing the ferro-cyanate of potassa to a red heat, for some time, or until decomposition takes place. The contents of the crucible are then to be thrown into water; and the hydrocyanate of potassa which is dissolved is to be separated from the iron and charcoal by filtration. On evaporating the solution, the cyanide of potassium remains in cubic crystals. One grain, placed on the tongue of a large Guinea pig, killed it in three minutes*. This salt is readily decomposed by sulphuric and muriatic acids, and hydrocyanic acid is evolved: thence it may be employed in the preparation of this acid; but it ought to be known that no hydrocyanic acid will be obtained if more than one proportion of the acids to one of the cyanide be employed†. When dissolved in water, it becomes a hydrocyanate; a portion of the water being decomposed sufficient to yield oxygen for converting the potassium into potassa, and hydrogen to form the cyanogen into hydrocyanic acid. One part of the cyanide and eight parts of water form a solution, which may be administered in the same doses as the hydrocyanic acid.

Dr. Buttigny and Dr. Lombard, of Geneva, have success-

* Journ. de Physiologie, &c. par M. Majendie, tome iii. p. 230.

† Ann. de Chimie et Phys. tome xlviii, p. 395, 401.

fully employed this preparation both in the state of solution and in the form of ointment externally in neuralgic affections. Dr. Lombard prepares the solution with from one to four grains of the cyanide to one fluid ounce of water; and the ointment with from two to four grains for every ounce of lard. Both are beneficial; but Dr. Lombard thinks that the solution acts more promptly than the ointment. Besides proving useful in neuralgia, this cyanide has been found to relieve the pains in chronic rheumatism. It is, however, according to Dr. Lombard, contraindicated when the nervous affection is complicated with a state of active inflammation. When chlorine cannot be instantly procured, cold water should be dashed upon the face and back, as recommended by M. Herbst; and brandy, ammonia, and other excitants, freely administered.

In whatever form hydrocyanic acid or its compounds may be administered, much caution is requisite in regulating the dose according to the strength of the patient and watching its effects: it is, therefore, important to know in what manner the symptoms of an overdose are to be counteracted. There is no time for freeing the stomach of its contents; and this is rendered almost nugatory by the immediate powerful effect of the medicine on the nervous system: it is, therefore, of high importance to ascertain what will immediately decompose the acid remaining in the stomach, whilst, at the same time, our attention is directed to overcome the general effect of the poison on the nervous system. With this object in view, the use of the ammoniated iron has been suggested by myself, and that of the sulphate has been recommended by M. Virey; but both are inferior to chlorine, which was first proposed by M. Simeon, whose opinions have been fully confirmed by series of experiments upon dogs by MM. Peresy and Novat. The chlorine so completely neutralizes the action of the hydrocyanic acid, that, in one instance, when respiration had been suspended for twenty-five seconds, and the animal apparently dead, it was rapidly revived by the chlorine, and in a short time recovered its usual vivacity. When the hydrocyanic acid has been swallowed, the chlorine may be given in the ordinary aqueous solution: when the

poisonous effects have resulted from inhaling the vapour of the acid, the chlorine may be administered in the gaseous form, largely diluted with atmospherical air.

Therapeutical Employment of Hydrocyanic Acid and its Compounds.

From the nature of the influence exerted by hydrocyanic acid and its compounds on the animal œconomy, it must be evident that the diseases in which it is likely to prove useful are those depending on an increased irritability of the nervous system and those connected with a state of excessive sensibility. Having determined this point, let us now examine in what particular forms of disease it has exerted a beneficial influence.

In no kind of idiopathic fever, either intermittent or continued, has hydrocyanic acid been employed; nor does my experience enable me to accord with the panegyrics which several writers have passed upon it as a remedy in hectic. In some of the order of diseases which nosologists have classed under the title Phlegmasiæ, it is said to prove beneficial, particularly in phrenitis and pleurisy. In the former I have never seen it employed; but as the inflammation of the membranes of the brain morbidly augments the general sensibility, manifested by the impatience of light and sound, it is likely to prove a useful addition to other remedies in this disease. It was first prescribed in pleurisy by the professors of the University of Padua and Pavia: but, notwithstanding the praises bestowed upon it, hydrocyanic acid is greatly inferior, as a remedy in inflammatory affections, to those medicines which directly influence the circulation. As far as the cough is concerned, it may prove beneficial; but, beyond that, it has no pretensions to be regarded as a remedy in this disease. In eruptive diseases, except as an external application, hydrocyanic acid holds forth no prospect of benefit. In the state of combination in which it is found in the bitter almond, it was employed as an external sedative so early as the time of Celsus, in a painful pustular disease which he describes as peculiar to infants. His formula is the following:—"lapides, quem pyriten vocant, partes octo, cum quinquaginta Amaris

nucibus miscetur, adjiciunturque Olei cyathi tres*." I have ordered the simple acid in the proportion of fʒii to six fluid ounces of bitter almond emulsion, as a lotion in Erythema nodosum : but candour obliges me to say that, in this affection, I do not think it more useful than the mixture of alcohol and water, which is more generally employed. In another very painful cutaneous disease, however, impetigo or running tetter, it performs every thing that can be desired from a topical application. I have generally ordered it, in combination with acetate of lead, in the proportion of fʒii of the hydrocyanic acid, sixteen grains of the acetate of lead, half a fluid ounce of alcohol, and fʒviii of *distilled* water. This lotion not only soothes the irritability of the diseased surface, but also disposes the skin to renew its healthy action ; and although Mr. Plumb has stated, as a caution against the external use of this acid, that, in two cases, of both legs, in which the eruption extended from the ankle to the knee, where it was employed, a considerable intermission of the pulse took place, yet I must say that, in upwards of fifty cases in which I have ordered it, no inconvenience has arisen ; on the contrary, it has been productive of the greatest comfort to the patients. In prurigo, inveterate psoriasis, and several other skin diseases attended with severe itching and tingling, it has rarely failed in affording equal comfort to the patient.

In hæmorrhagic affections of an active nature experience authorizes me to place some confidence in this acid. In cases of this description I have rapidly augmented the dose from m. iii, the medium dose, to m. xii, or until the pulse began to give indications of the powerful influence of the medicine ; and in very few instances, where there was not some formidable organic disease, have my expectations been disappointed. In phthisis, the powers of hydrocyanic acid have been greatly overrated. Given in small doses, and frequently repeated, it certainly diminishes the hardness and the frequency of the cough, and lessens the general hectic tendency : but I am of opinion that so much is not to be expected from it as from some of the narcotics. As a palliative, nevertheless, it is not without its value : it moderates the cough, and often

* Celsus de Medicina, lib. v, § 15.

favours sleep, without increasing those sweats which are too frequently augmented when opium is employed. In the last stage of the disease, it hastens the termination of the case, by adding to the debility which already exists: indeed, it is in the early stages only of this intractable disease that hydrocyanic acid can be regarded as likely to prove beneficial even as a palliative. Its employment in the state in which it is found in laurel water is of no recent date; as most of the old works on Consumption enumerate laurel water amongst the means to be employed for soothing the cough. If M. Jorg's conclusions respecting the action of this water were admitted, its use would certainly be contraindicated in the early stage of phthisis, as well as in every inflammatory affection of the lungs: but this is contrary to general experience. I have found it almost specific in that affection of the trachea which has been named Phthisis trachealis; and which, if the inflammation of the mucous membrane be allowed to run on to ulceration, is as fatal as consumption of the lungs.

In chronic catarrh, I have seen sufficient proofs of its efficacy to authorize me to recommend it; and although my opportunities of prescribing it in dysentery have been very limited, yet they have been satisfactory. I have generally ordered it, at the same time with full doses of calomel, to the extent of four minims for a dose, in the bitter almond emulsion. On the principle of allaying irritation, and thereby favouring a slower, and consequently more healthy, gastric secretion, I was induced to try the influence of the hydrocyanic acid in dyspepsia; since which the benefit resulting from its employment in this disease of the learned and literary part of society has been laid before the profession by my colleague Dr. Elliotson. In this disease, the simplest mode of administering it is the best: I therefore usually order it to be taken dropped in water, from three to five minims for a dose, with the addition of $\frac{fj}{i}$ of the tincture of calumba. In pyrosis it affords relief on the same principle, by allaying the irritability of the stomach, and permitting the secretion of a more healthy gastric juice.

It is in the spasmi that the powers of hydrocyanic acid are most conspicuous. It is curious, although M. Jorg admits its

influence, as found in cherry laurel water, in lessening nervous sensibility, that he should yet regard it as contraindicated in spasmodic affections where the cause is excitement of the brain, or turgescence of its vessels. I conceive that, in no class of diseases more than in the spasmi, is hydrocyanic acid, either in its free or combined state, likely to prove useful. In tetanus, chorea, and epilepsy, I have had no experience of its influence: but in asthma, even when the pulse is small, irregular, and often not easily distinguishable, I have seen it act almost as a charm, in removing the suppressed breathing, and restoring the free play of the respiratory organs. In hooping cough, I regard it as the sheet anchor of the practitioner; and do not think I am stretching my praise of it too far, in affirming that few cases of this disease would prove fatal, were the hydrocyanic acid early resorted to and judiciously administered. After emptying the stomach with an emetic, and purging briskly, the use of the acid should be begun, and the prescription never altered, except to increase the dose of the acid. When thus treated, the disease seldom continues more than a month or five weeks. It is necessary to confine the little patients to a graduated temperature, and to keep them altogether upon a milk and vegetable diet.

Such are the chief diseases in which hydrocyanic acid, operating as a sedative, has been found beneficial. I am of opinion that advantage would be derived from employing the cyanide of potassium, both on account of its being easily preserved and retaining its strength, which never varies when it is properly prepared, and also from its cheapness. The cyanide might also be employed for furnishing the free hydrocyanic acid, by adding to one proportion of the cyanide in water either sulphuric or muriatic acid, and distilling in a large retort, with a gentle heat, into a cool receiver. It has been proposed to employ the essential oil of bitter almonds, instead of the free hydrocyanic acid; on the plea that the strength of the medicine can be more certainly determined; that it is less likely to suffer change from air, light, variations of temperature, and age: and there is some truth in these reasons. Twelve drops of the volatile oil of the bitter almond may be regarded as equivalent to m. iv of the ordinary medi-

cinal acid. One objection to the use of this oil is the powerful effect which it has on individuals of a peculiar idiosyncrasy; namely, that of producing a rash resembling nettle rash. In some people, eating a single bitter almond will produce nettle rash, vomiting, and vertigo; and it is probable that this depends on something in the fruit, independent of the hydrocyanic acid; as instances are met with in which the sweet almond causes the same inconveniences, although no hydrocyanic acid has ever been found in it.

Although the oil of bitter almonds may be used internally in the same manner as the hydrocyanic acid, yet it requires more care as an external application. I once ordered it as an ointment, largely diluted with spermaceti ointment; but the effects were such as to prevent me from again using it: and Coullon has recorded the case of a child who was killed by the leaves of the *Prunus laurocerasus* applied to a sore on the neck.

b. TOBACCO.

1. *Empyreumatic Oil of Tobacco*.—This oil is produced in the ordinary process of smoking, or whenever the dried leaves of the tobacco are submitted to destructive distillation.

The experiments of Mr. Brodie have rendered it probable that there are two active principles in tobacco; one the essential oil of which I am treating and which operates directly on the brain and nervous system and the general sensibility of the habit; the other a saline substance, Nicotina, which appears to act chiefly on the motor nerves, confining the sphere of its influence particularly to the heart, which it renders insensible to its natural stimulus the blood, and thereby causes death.

The extraordinary effect of the empyreumatic oil of this plant, accumulated in the wooden stems of the pipes of the Hottentots, in instantaneously destroying serpents, is well known. In whatever manner this oil is procured, it is extremely virulent in its effects upon the animal œconomy, so that, when introduced into a wound, it causes instant death.

When dried tobacco leaves are infused in boiling water, the empyreumatic oil is not present; and the sedative effects which always result from the exhibition of the medicine, in

this form, as an enema, is probably due to the *Nicotina* which is combined with some acid in the tobacco that renders it soluble. The energetic nature of this sedative is such, that, when swallowed in doses of a grain, the action of the heart ceases even before that of the diaphragm—an effect directly the opposite of that which results from the administration of hydrocyanic acid. It is the presence of the oil, however, which renders the smoke so powerfully sedative.

2. *Nicotina*.—This substance is regarded as the active principle of tobacco in its natural state. It may be procured in a separate state by a process suggested by Vauquelin*. It is colourless, has an acrid taste, and the peculiar odour which distinguishes tobacco, and, like it, causes violent sneezing when snuffed up the nostrils. It is soluble both in water and in alcohol, and approaches, in its chemical properties, to the volatile oils. It is precipitated from its solutions by tincture of gall nuts, which also throws it down in the infusion of tobacco leaves.

When a person unaccustomed to smoking takes a pipe for the first time, he soon becomes sick and vomits, the force of the circulation is reduced, great muscular debility, vertigo, insensibility, and cold sweats, supervene; and a considerable period elapses before he regains his former healthful feelings. The same symptoms follow the application of tobacco to the skin; for example, in the form of cataplasm to the pit of the stomach, or of lotion to the scalp; and these symptoms are still more severe if the infusion of the dried plant or the smoke be thrown into the rectum. Upon the whole, it is evident that Tobacco is a direct sedative, whether employed in the form of infusion or in that of smoke.

This sedative influence of Tobacco is taken advantage of for the relief of several diseased states of the body; and, reflecting on its violent action on the nervous system, it is not extraordinary that it is not much employed. The infusion, in the proportion of ʒi of the dried plant to a pint of boiling water, is frequently employed in cases of incarcerated hernia: great muscular debility and relaxation soon follow, and the gut is often then readily replaced. The aid thus afforded,

* Ann. de Chimie, tome lxxiv.

however, to the taxis is sometimes attended with a degree of hazard; and, from the irregularity of the action of the remedy in different individuals, and the frightful extent of its influence, it is not to be inconsiderately resorted to, nor, indeed, at all whilst there is the least chance of any other means proving useful. It has, also, been remarked, that those who have been subjected to the influence of the tobacco clyster, if the operation for hernia has been still necessary, do not recover so well as those on whom it has not been tried. The Tobacco enema has also been used for destroying ascarides, and at the same time expelling them from the rectum; but it is too hazardous a remedy to be employed for this purpose. The infusion has also been applied topically in cases of scabies and in other cutaneous affections; but the most serious consequences have resulted from this practice.* The sedative influence of Tobacco has been taken advantage of in other diseases: smoking it relieves toothache, and abates the severity of the paroxym of spasmodic asthma; and Dr. Fowler has recommended the internal administration of the infusion in dropsy. But, under all circumstances, Tobacco must be employed with the utmost caution.

When Tobacco produces its deleterious effects, like hydrocyanic acid, it operates too instantaneously on the nervous system to admit of the employment either of the stomach pump or of emetics; we must, therefore, have recourse to some chemical reagent which will render its activity inert; and at the same time we must rouse the depressed powers of the system by every means in our power. The best substance for fulfilling the first indication is the infusion of nut galls, or of any other astringent infusion; the effect of the tannin or the gallic acid being a precipitation of the Nicotina in its uncombined state, in which form it is scarcely soluble, and therefore ceases to be active. To fulfil the other indication and support the vis vitæ, brandy, ammonia, and other stimulants, must be resorted to; and, bearing in recollection the effects of artificial respiration, in the experiments of Mr. Brodie, there is every reason for supposing that this method of maintaining the function of the lungs might prove beneficial if an

* Ephem. Cur. Nat. Dec. 2. Ann. 4, p. 467.

admixture of oxygen gas with common air were used. I feel the force of an objection that may be raised in this case: it may be stated that artificial respiration is useful only when the lungs and heart do not share in the shock given to the sensitive part of the frame, as in cases of poisoning by hydrocyanic acid; whereas, when tobacco is employed, the motor nerves are those principally affected. I admit the correctness of the reasoning; but, at the same time, I feel that by stimulating the heart and pulmonary system, this set of nerves may be again roused into activity; and I cannot avoid expressing my opinion that the impression of sedatives on the motor nerves, although almost as rapidly induced as the same impression on the nerves of sensation, yet is more transitory, and consequently more easily relieved.

d. SULPHUR WITH HYDROGEN.

Pure sulphur exerts no depressing influence on the animal economy; but some of its combinations are powerful sedatives: two only of these require to be noticed.

1. *Sulphuretted Hydrogen Gas*.—This gas, in combination with aqueous vapour, is exhaled from sulphurous springs and baths; and it was from observing the effects of these exhalations on animals that we became acquainted with its influence on vitality. It may be artificially prepared by acting upon protosulphuret of iron* with sulphuric or muriatic acid, diluted with three or four parts of water; or by heating one part of sulphuret of antimony, in a retort, with four or five times its weight of muriatic acid. In both instances sulphuretted hydrogen is formed, and escapes with effervescence, while the metal is changed into a protoxide and unites with the acid employed. It is probable that the oxygen for oxidizing the metal, and the hydrogen for uniting with the sulphur, are obtained from the decomposition of a portion of the water.

Sulphuretted hydrogen gas thus procured is colourless,

* As protosulphuret of iron is useful for many purposes, the practitioner should know how to prepare it. It is readily procured by exposing to a low red heat a mixture of two parts of iron filings and one and a fourth part of sulphur in a Florence flask, or a common earthen crucible fitted with a cover.

and elastic like common air; it has a fœtid odour, resembling that of putrefying eggs: its specific gravity is 1.1805; 100 cubic inches weigh 36.006 grains. It does not support combustion, which seems to be the case with all the acid gases. It is rapidly absorbed by water: 100 cubic inches of water taking up 253 of sulphuretted hydrogen gas, and the solution reddens litmus. It cannot be breathed with safety unless largely diluted.

When set on fire, it burns with a bluish red flame, and, as the combustion is incomplete, it deposits much sulphur. It explodes when one measure of it is mixed with one and a half of oxygen gas, and fired; water and sulphurous acid being formed.

It is evidently sulphur, acidified in a peculiar manner by hydrogen, and held in solution in hydrogen gas. It consists of

Sulphur 33.888 or 1 prop. = 16

Hydrogen 2.118 — 1 prop. = 1

Equivalent 17

It is readily decomposed by chlorine, which, uniting with the hydrogen, forms muriatic acid, whilst sulphur is deposited; it is also decomposed by sulphurous acid, which is itself decomposed, and water formed with a deposition of sulphur; and by iodine, which attracts its hydrogen to form hydriodic acid, whilst sulphur is deposited.

This gas is extremely deleterious to animal life, even when much diluted. MM. Thenard and Dupuytren ascertained that an atmosphere of common air, holding 1-800th of it*, will quickly kill a middle-sized dog: and Professor Chaussier ascertained that it proves fatal even when merely applied to the skin or the mucous membrane in a concentrated state; a rabbit, whose skin only was exposed to it, died in ten minutes; and a horse, into whose anus ten quarts were injected, died in one minute.†

Workmen employed to empty privies and drains often suffer from this gas. They become suddenly weak and in-

* Orfila's *Toxicologie Générale*, tome ii, p. 479.

† Sedilott's *Journal de Med.* tome xv, p. 28, 34.

sensible; and, if the gas be concentrated, they fall down and suddenly expire*. If the gas be much diluted, either coma or delirium, followed by tetanic convulsions, succeeded by a cold clammy skin; feeble, irregular pulse, and frothing at the mouth, take place.

Post-mortem dissections of persons killed by this gas exhibit a black, thin state of the blood; annihilation of the contractility of the muscles; and a putrescent colour of the whole viscera; and silver or white lead, thrust under the skin, is immediately blackened.

In cases of asphyxia by this gas, water should be dashed on the chest, and artificial respiration employed: if the person revive, ammonia and other stimulants should then be administered.

I am not aware that this gas, either in the gaseous form, or in solution in water, has ever been actually used as a therapeutical agent, although its employment in phthisis has been suggested: but the great caution which is requisite to prevent dangerous effects from resulting, will always operate as an obstacle to its general employment. I have noticed it here rather to afford an opportunity of mentioning the following fact, than for any other reason. Much of the depression which occurs in those diseases which are termed nervous, and in febrile affections of a low kind, seems to depend upon the extrication of large quantities of this gas in the intestinal canal. In all these cases the fæces have the most offensive odour, and that this is owing to sulphuretted hydrogen gas is evident, both from the odour itself closely resembling that of the gas, and also by the blackening of slips of paper soaked in subacetate of lead, when held over the vessels containing the fæces. The practical inference to be drawn from this fact is, that solution of chlorine, or the chloruret of soda, should be administered in these cases.

2. *Hydro-sulphuret of Ammonia*. E. D.—This combination of sulphuretted hydrogen and ammonia is readily prepared

* No drains or pits of necessities should be entered until the presence of this noxious gas be determined, by first letting down into them a piece of paper moistened with a solution of subacetate of lead. If this become black, there is risk in descending into these places.

by passing a stream of sulphuretted hydrogen gas through a solution of pure ammonia, in a Wolfe's apparatus. It may be procured in a dry state by the direct union of its constituent gases: if they be passed into a glass globe kept cool by ice, the hydrosulphuret is deposited in crystals on the sides of the globe.

Hydrosulphuret of ammonia, thus prepared, is of a green colour; has a very foetid odour, and an acrid pungent taste. It attracts, powerfully, the oxygen of the atmosphere, and thus undergoes decomposition; consequently it ought to be preserved in small bottles, well stopped, and kept full. It is decomposed by acids. When the ammonia is not neutralized, it renders turbid the sulphate of magnesia in solution. It consists of 50 parts of sulphuretted hydrogen, and 50 of ammonia, or of 1 prop. of Sulph. Hydrogen = 17, + 1 of ammonia = 17, making the equivalent 34.

As a Sedative, it lessens the action of the heart and the arterial system by acting directly on the nervous energy; and, even in moderate doses, causes nausea, vomiting, drowsiness, and vertigo. Mr. Cruikshanks proposed its use in diabetes mellitus, with the view of diminishing the morbid action of the digestive organs.

The dose is m. v in a tumbler of water three or four times a day; increased until vertigo takes place.

e. CARBON WITH HYDROGEN.

Carburetted Hydrogen Gas.—Carbon, like sulphur, acquires sedative properties by combination. The gas now under consideration is abundantly exhaled from the surface of stagnant water; and it forms the greatest part of that gas which escapes from the crevices in coal mines, and is well known to miners under the name of *fire-damp*. For medicinal purposes, it may be procured by passing steam over ignited charcoal: the water is decomposed, the hydrogen combines with as much of the carbon of the charcoal as it can dissolve, forming carburetted hydrogen; while the oxygen, uniting itself to another portion, passes off in the form of carbonic acid gas.

Carburetted hydrogen gas possesses all the physical pro-

perties of common air ; it is colourless, and has neither taste nor smell. Water absorbs about $\frac{1}{80}$ of its volume. Its specific gravity is nearly $\frac{1}{2}$ of that of common air, or 0.554 ; and it is highly elastic. 100 cubic inches of it weigh nearly 17 grains. It is a compound of 1 prop. of Carbon = 6, + 2 of Hydrogen = 2, equivalent 8. It is unable to support combustion or respiration, but is inflammable, burning with a clear yellow flame. It forms a large portion of that mixed gas, which is procured from the distillation of coal, with which the streets are lighted. When mixed with certain proportions of atmospherical air, or with oxygen, and ignited, it explodes violently, producing carbonic acid and water ; and it is this admixture which is exploded and produces such fatal consequences to miners.

Of all the kinds of sedative unrespirable gases, except sulphuretted hydrogen, this is the most deleterious to animal life ; producing, when taken into the lungs, even in a diluted state, almost instantaneous death ; and so complete a destruction of nervous energy, that animals thus destroyed cannot be recovered under any circumstances. When a person inspires it, even combined with three times its bulk of oxygen, he becomes sick ; his lips turn livid ; his pulse instantly sinks ; and, on the third inspiration, the irritability of the lungs is destroyed. In cases where death does not ensue from the large dilution of the gas, the consequences of breathing it are felt for twenty-four hours. Notwithstanding these effects, however, no gas is so soon habituated to the system. Miners get accustomed to it, and breathe it, in a diluted state, with impunity—a fact which demonstrates how soon the habit gets accustomed to deleterious atmospheres.

This gas has been employed for medicinal purposes, as a Sedative, diluted with 20 or 30 times its bulk of common air ; and, even in this state of dilution, it cannot be respired for more than a few minutes at a time, as it causes nausea, dizziness, and symptoms of great depression. It has been employed in phthisis ; and could it be used with sufficient caution, it is more likely to prove useful, as a remedial agent, than any of the other gases. Its obvious effects are those I have already stated ; it also diminishes pain : when employed, it should

be at first diluted with thirty times its weight of atmospherical air, and gradually increased in strength ; that is, the quantity of common air should be gradually reduced to twenty times the bulk of the carburetted hydrogen.

INDIRECT SEDATIVES.

These are comparatively few in number ; and, although their influence is felt upon the nervous system, yet it is more immediately experienced by the circulating medium, operating either by altering its properties so as to unfit it for affording a due stimulus to the brain and nervous centres, or diminishing its quantity so as to cause a similar state of the brain from defect of excitement, or, as it were, from inanition. The first of the Indirect Sedatives requisite to be noticed is

f. CARBONIC ACID GAS.

This gas is formed in many common operations ; in burning fuel, in calcining limestone, and in fermenting liquors : it is exhaled in the dark by plants, and emitted during the respiration of animals : it also accumulates in wells that have been long out of use, and in old, ill-ventilated cellars. It is easily procured for medicinal use from the decomposition of marble, which is a carbonate of lime, by means of muriatic acid, diluted with two or three times its weight of water. If five ounces of white marble be decomposed by two drachms of muriatic acid, diluted with four drachms of water, three hundred cubic inches of carbonic acid gas will be obtained.

Thus procured, Carbonic acid gas is colourless and transparent, having all the physical properties of common air. 100 cubic inches of it weigh 46.597 grains, when the barometer stands at thirty inches ; thence its specific gravity is 1.527. It checks combustion, and cannot support respiration. It renders lime-water turbid ; but, when it is held in solution in water, it dissolves carbonate of lime. Water absorbs it, and receives from it an agreeable, acidulous taste ; and the solution reddens litmus. It is from the extrication of this gas in fermented liquors that they derive their briskness. It has also a curious property of passing by endosmose through animal membranes and displacing oxygen.

Carbonic acid is a compound of 1 prop. of Carbon = 6, + 2 prop. of Oxygen (8×2) = 16, making the equivalent 22 ; or 100 cubic inches consist of 33.888 grains of Oxygen and 12.709 grains of Carbon.

When carbonic acid is dissolved in water and taken into the stomach, it appears to act as a tonic upon the nerves of that viscus, raising the spirits and increasing the appetite ; but, when it is in the state of gas, it is an undoubted sedative. A question, however, has been raised, whether this gas is positively or negatively sedative ? That the latter opinion is correct has been inferred from the fact that, when the body is immersed in carbonic acid gas, whilst atmospherical air is freely admitted to the lungs, all the sedative symptoms produced by this gas occur ; as, weight in the head, vertigo, dimness of sight, singing in the ears, &c. But, although this be admitted, yet the sedative effect caused by breathing carbonic acid gas is supposed to be negative. As soon as the gas is attempted to be inspired, the glottis contracts, and none of the gas enters the air-tubes of the lungs ; but death ensues in the same manner as in drowning or in strangulation. This is so very complete, that it occurs even when the gas is mixed with nearly an equal bulk of atmospherical air ; and the operation is more speedy than that of any other mode of suffocation. But, although carbonic acid gas does not enter the cavity of the lungs, and produces death by shutting out the agent by which the lungs frees itself from the carbon which the blood becomes charged with in the course of the circulation, and without obtaining a freedom from which life cannot be sustained, yet it must be admitted that it causes a condition of the heart which leads to the supposition that it acts also on the irritability of the nervous system, destroying it in the same manner as sedative poisons*. It is also true, that, independent of its effects when respired, carbonic acid exerts a sedative influence on the habit. Dr. Priestly, having excited pain in a blistered part by immersing it in oxygen, relieved the pain instantly by plunging the hand into a jar of carbonic acid gas. If cancer has proceeded to a state of open ulceration, a stream of car-

* In its concentrated state, carbonic acid gas destroys plants as well as animals.

bonic acid gas, which has passed through water, and is directed on the part by means of a flexible tube, affords considerable relief to the pain ; and it is the extrication of this gas, in the fermentation of those vegetable matters which constitute the fermenting poultice, that affords the relief obtained from them.

These sedative effects of the local application of carbonic acid gas led to the employment of it as a remedy in phthisis ; but, although it appears to lessen the expectoration and to improve some of the symptoms, yet, as may be readily supposed, no cures have been effected by it. The carbonic acid, in this case, is respired largely diluted with common air ; and, from the effect of this gas which I have already mentioned in constricting the muscles of the glottis and keeping it shut, the dilution must be very great indeed before it can be respired.

g. BLOOD-LETTING.

The blood is a primary fluid, and its quantity is greater than that of any other in the body : it is the pabulum of the solids, the source of every secretion, and, with the exception of the epidermis, the enamel of the teeth, the body of the crystalline lens, and a few other parts which are known as exsanguineous, it is generally diffused through the system. It first passes through a series of gradually diminishing tubes, the arteries, propelled by the action of the heart ; and it is again returned to that viscus through another series of gradually enlarging tubes, or *veins*. In man, the average quantity of this circulating fluid, in proportion to the weight of the body, in a healthy adult subject, is as *one* to *five* : when the relative proportion is greater than this, an unnatural or diseased state of the habit exists, which has been named *plethora* : when a smaller relative proportion is present, the body becomes emaciated : when it is suddenly abstracted, a series of phenomena occur which display a diminished degree of vitality : and, if the quantity taken away exceed a certain proportion of the whole, death immediately ensues. The abstraction of a certain proportion, therefore, produces a sedative effect on the habit. According to the manner in which the blood is abstracted, blood-letting is regarded as general or local.

General Blood-letting is effected either by *venæsection*—that is, a mechanical division of the coats of a *vein*, in which the current of the blood towards the heart has been previously obstructed by a ligature—or by *arteriotomy*, the mechanical division of an artery. The influence of either of these operations on the general œconomy is determined by the quantity of blood abstracted ; but the effect of this varies in different individuals, according to the strength and the constitution of the patient ; and, in the same person, according to the period of life, the state of health, and the manner in which the abstraction is accomplished. Before passing to the consideration of blood-letting as a sedative, it will not be superfluous to enquire into the uses of the blood in the living system. I have already said that it supplies the *materials* of the solids originally, and is afterwards their nutriment or pabulum ; and that from it all the *secretions* or fluids prepared by the functions of the living body are derived. But, what is more necessary for us to know, it is the agent which excites the heart to action and maintains the temperature of the body.

The action of the heart commences in the second or third week after conception, and continues to the last moment of existence ; and its structure is admirably adapted for this perpetual and equable motion. The contraction and relaxation of the ventricles and auricles can be distinguished by distinct sounds, on placing the ear on the chest of a healthy person, between the cartilages of the fourth and seventh ribs, or under the lower part of the sternum. The action of the ventricles is a dull sound ; that of the auricles a clearer sound, similar to the noise of a valve, or somewhat like the licking of a dog. This action of the heart communicates an impulse to the arteries, which is manifested to the finger in all those arterial branches which do not exceed one sixth of an inch in the diameter of their canal, and constitutes the pulse, every beat of which indicates the *systole* or contraction of the heart. The diversity of the pulse at various periods of life, in different sexes, and as modified by climate, has been well ascertained. It is also altered by watchfulness, sleep, exercise, the depressing and exciting passions, meals, the discharge of the seminal fluid, and disease ; and it is this index of velocity, force, ten-

sion, and general state of the mobility of the heart, which, in most instances, enables us to decide as to the propriety of abstracting blood. The celerity of the blood in health varies, not only in different persons, but in the same individual in different parts of the body ; the velocity being greatest in the arterial trunks, in the ratio of diminished friction, and less in the branches. During health, in an adult, there are from 68 to 75 pulsations in a minute, depending on contractions of the heart closely connected with its irritability ; and that this is attributable to the nerves is very evident, from the influence of the passions over it, and its sympathy with the stomach, as displayed in various diseases. It thus appears that the blood passes through every part of the system ; and, in doing so, it undergoes some important change ; as it differs in its characters in the veins and in the arteries. But these circumstances only refer to the blood, in a healthy state of the body, circulating in due quantity : let us now endeavour to consider some of the changes which follow from its abstraction.

During life, the blood vessels are always in a certain degree of tension, by which the tone of the system is maintained : blood-letting, diminishing this tension, is followed by relaxation and debility ; and consequently this operation produces a sedative effect on the frame. The first effect of the general abstraction of blood, by opening a vein in the arm, is diminished tension, not only of the blood vessels, but of the whole system ; the secretions are less copious, from part of the supply of blood being cut off ; and perspiration becomes more free. As the blood continues to flow, the patient begins to feel slight dizziness ; singing in the ears ; a loss of consciousness ; and, in proportion to this, the breathing is more or less affected, being generally suspended until the painful sensation produced causes deep and repeated sighs, after which it is again suspended ; the pulse becomes slow and weak, the face pale and bedewed with perspiration ; and sickness follows. In reflecting on the symptoms as they arise, they evidently indicate that the brain is the organ the function of which is first impaired, and this appears to be the result of the defect of stimulus ; the respiration suffers as an immediate consequence ; and the enfeebled action of the heart is

not only the effect of a deficient quantity of blood, but of its defective arterialization in passing through the lungs. On recovering from such a state, there is not unfrequently a transitory delirium, yawning, a return of consciousness, irregular sighing, deep-drawn breathings, and gradual development of the pulse.

The mode of performing the blood-letting very much regulates the effect. A large quantity of blood may be abstracted without any considerable effect, if it be taken slowly and gradually through a small orifice, and if the patient be in the horizontal position; syncope is induced if it be taken suddenly through a large incision, and if the patient be seated or in the upright position. This depends on the tension of the whole system, which, on the sudden abstraction of the blood, is more rapidly removed than will allow the vessels to adapt themselves to their contents; and on this account it seldom occurs in local or topical bleeding, the abstraction of the blood being slow and confined to the part on which it is performed. In ordinary venæsection, also, the abstraction being less rapid than in arteriotomy, the momentum of the blood greater in the arteries than in the veins, the production of syncope is less rapid. These effects of the different modes of blood-letting are important to be recollected in a practical point of view, in the employment of blood-letting as a sedative. Arteriotomy is now rarely performed, except in cases of apoplexy or phrenitis, when a sudden and very powerful effect is requisite; as syncope can always be obtained by venæsection, if the orifice be sufficiently large and the patient be placed upright. If the blood-letting be carried beyond a certain point, instead of the symptoms which I have been describing as indicating recovery from syncope, the countenance becomes more pale and sunk, the breathing becomes stertorous, and terrible gasping follows; the pulse sinks until it becomes imperceptible; the animal heat fails, and cannot be restored to the extremities by any external warmth; there is constant restlessness and jactitation; every thing indicates an exhausted state of the energies of the brain; and the patient sinks, gasps, and expires. When the abstraction of blood is within more moderate bounds, the effect produced is

the result, in some degree, of the mere mechanical influence of diminished tension ; for the momentum of a moving body being in the direct ratio of its weight, this is diminished ; and the moving power remaining the same, the velocity of the body being in the indirect ratio of its bulk, the velocity is increased : thence the mechanical result of a general abstraction of blood is to diminish the force, but to augment the velocity of the blood. As the pulse is thus rendered feebler, so it is softer ; and this diminished tension being extended to the whole system, it becomes languid, and the action of the heart weaker. Some effect is also produced on the blood itself. Considered as a mechanical mixture, the serum is increased in quantity and the crassamentum diminished : the coagulability is augmented, but the coagulum is less firm. Whether in its chemical constitution any change is effected by the production of syncope, has not yet been clearly ascertained.

Many other circumstances, besides the mode of abstracting blood, demand attention as modifying the result of the operation :—these are age, temperament, sex, mode of life, climate, and the quantity abstracted. Let us examine each of these.

With regard to age, in infancy the laxity of the solids, and the relative proportion of the serum or watery part of the blood to the crassamentum or clot, which consists of fibrin and colouring matter, are more considerable than in adult age : blood-letting, by increasing this greater proportion of serum, proves hurtful ; and a state of syncope in infants is always one of great danger. The first effects of exhaustion in such young subjects is an increased degree of irritability, which leads to stupor, and generally terminates in convulsions : the pulse is quickened, the pupil of the eye dilates, and symptoms closely resembling those which precede the effusion of water in the ventricles present themselves. I have seen this more than once occur in children in whom symptoms resembling those of inflammation of the brain, accompanying irritation of teething, have displayed themselves ; and leeches or cupping has been resorted to ; but, instead of affording relief, a state of evident defective stimulus super-

vened ; and, in one case, snoring, stertor, and other appearances of apoplexy, having followed the bleeding, more leeches were applied, and the infant died. This state is detected readily by attention to the state of the breathing, which seems to be performed almost wholly by the diaphragm ; and is always accompanied with the evolution of much flatus : both circumstances denoting a very low state of the nervous energy. It is best obviated by white wine whey, opium and ammonia, administered warm, in small quantities, and frequently repeated. In youth, and in the vigorous and robust, on the contrary, reaction takes place, and is especially marked after repeated venæsections : the most favourable age for bearing blood-letting is from eighteen to forty-five. In old people the reaction is extremely feeble ; and, during the flow of the blood, exhaustion often steals on so insiduously and imperceptibly, that, when nothing injurious is anticipated, syncope appears ; no reaction can be induced, or it is defective, and gives way to a state of positive sinking. The risk in such a case is extreme.

With respect to temperament, those possessed of a sanguine temperament bear blood-letting worst. In these, therefore, it must be used with more caution than in the phlegmatic or the melancholic. But the capacity of supporting the loss of blood is not always to be ascertained by its effects in producing syncope ; nor is this always to be regarded as the translation of reaction into exhaustion ; the syncope often proceeding from a peculiar idiosyncrasy. Some strong and vigorous persons faint on losing the smallest quantity of blood ; others, even of weak and puny habits of body, bear large abstractions of blood without feeling even the approach of syncope. I have observed this in men who, from their occupations and known courage, could not be suspected of being influenced by fear, which is not unfrequently a cause of syncope in women. Men, however, owing to the nature of their organization, and their higher degree of tone, bear, in general, blood-letting better than women. Some circumstances connected with sex, also, the state of menstruation being present, have usually rendered practitioners cautious of abstracting blood : but if the patient be labouring

under acute inflammation, or any state of disease which requires blood-letting, it is not to be omitted on this account.

I have said that the mode of life, also, modifies the effects of blood-letting. The inhabitants of the country, engaged in agricultural occupations, and much in the open air, bear the loss of blood better than those of the town; those of active, better than those of sedentary habits: thence the sportsman than the studious man, the labourer than the man of science. It has been often supposed that the luxurious and self-indulgent are more able to bear bleeding than the moderate and the temperate: but this is not the case; for although luxurious indulgence favours plethora, yet it also is accompanied with a laxness and debility of habit, which is soon exhausted by the abstraction of blood.

With respect to climate, venæsection is better borne in temperate than in either hot or cold climates. In warm climates, although inflammatory states of the habit, with topical inflammation, frequently occur, yet these are always accompanied with increased irritation, and sooner followed by a state of collapse than inflammatory affections occurring in temperate climates; thence the lancet is to be used with caution. Under the influence of pure inflammation, the sedative influence of general blood-letting is less felt than even in a state of health; this state, as has been well remarked by Dr. Marshall Hall, in his valuable Treatise on the Morbid and Curative Effects of Blood-letting, being "a sort of concentrated and permanent stimulus, exciting and maintaining the powers of the system," and "whilst it exists, constituting a stimulus and a protective power against the influence and effects of loss of blood" (p. 203). Now, as this state more frequently occurs in temperate than in warm climates, the loss of blood is better borne in the former. In cold climates, the rapid reduction of the animal temperature, produced by blood-letting, is one reason for employing it with caution: indeed, this is not confined to blood-letting, but the rule extends to the employment of all Sedatives.

But the most important circumstance to be attended to, as modifying the effects of the abstraction of blood, is the quantity which can be borne by the patient. From what has been

already said, it must be obvious that the degree of Sedative effect produced must be in the direct ratio of the quantity abstracted. Fashion has too much regulated this ; and, at one time, we find practitioners bleeding with a small orifice, and in moderate quantity, on all occasions ; at another, abstracting the most hazardous quantities of the vital fluid, with the largest orifice : consequently, in the most sudden manner, and with a degree of indiscriminate rashness, which to the eye of judgment is truly frightful. Both extremes are improper. The due quantity must be regulated by the constitution of the patient and the nature of the disease. It has been ably argued, in the work to which I have already alluded, “ that the power and susceptibility of the system, in regard to the effects of the loss of blood, may generally be determined by placing the patient in the erect posture, perhaps with the eyes turned towards the ceiling, and taking the blood from a moderate-sized orifice, until the first or slightest appearance of syncope be induced ; the quantity of blood which thus flows denotes that power or that susceptibility respectively.” It is also argued that this first appearance of syncope manifests the quantity to be taken, the power of the system for supporting the loss of blood being exactly in proportion to the necessity for blood-letting. But, from what has been previously said, although this rule may hold good in many instances, yet there are exceptions to it ; and mischief might result if too close an adherence to the general rule were observed. I have witnessed cases of decided inflammation, in which syncope occurred after three or four ounces of blood were taken ; yet, on repeating the operation in a few hours afterwards, from twenty to thirty ounces were abstracted without the least evident approach of syncope. On the other hand, we are always to wait for the approach of syncope ; for although the inflammatory state of a disease renders the system, otherwise incapable of bearing the loss of much blood, able to sustain it, yet this protecting influence is not always marked by the non-appearance of syncope. In the lectures of Mr. Lawrence (published in the *Lancet*, No. 325), is the case of a young female of slender habit, in whom depletion was tried to its full extent, and eight-and-forty ounces of blood taken

away without fainting being produced. " 'The blood,' says Mr. Lawrence, " still ran out in a vigorous stream into the vessel, without touching the surface of the arm, to the very last. In the end I stopped it, because the quantity did seem to me to be so very great. Now," continues he, " that single venæsection cured her ; she was well from that time ; all the symptoms were removed ; she had no further symptom whatever indicating inflammation of the chest." Upon this case we may remark, that we are to discriminate as to the quantity of blood taken, without, in every instance, waiting for indications of syncope ; as this is not invariably necessary in order to secure the beneficial sedative influence of blood-letting. It is not improbable that, if the blood had been permitted to flow in this case until the tendency to syncope displayed itself, the transition from reaction to sinking would have been sudden ; and, if the patient had rallied for a little time, the effects might have been such as to have terminated fatally. It is the last drop of blood abstracted, which either relieves the diseased state or hurries on the fatal issue : the reaction may be moderate and salutary, or a state of sinking and sudden death may follow, if we proceed till a tendency to syncope occur, and the bleeding has been carried to a considerable extent before this state present itself. If, during the flowing of the blood, the pulse become fuller and stronger, the power of bearing the depletion, and the necessity for it, are both indicated : if the pulse become small and feeble, the bleeding must be stopped.

It is not easy to reconcile the accounts of the large abstractions of blood often taken by the older physicians with what the habits of the present race of men will bear, without conceiving that some change has taken place in the human constitution. In acute rheumatism, Sydenham, who practised in London, used to order forty ounces of blood to be abstracted—a degree of depletion which could not now be ventured upon in this disease. The inactive habits of more civilized men, the higher cultivation of intellect, the less necessity there exists for the aid of mere brute force in the works of the artizan, and the general use of spirituous liquors instead of beer, may, in some degree, account for this change

of constitution. Another practice has also been discontinued by well-informed physicians, which was formerly prevalent ; that is, the repetition of venæsection as long as the appearance of a buffy coat in the blood presents itself. This custom arose from the erroneous idea of the nature of this coat : we now know that it depends on the slow coagulation of the blood, which occurs from the change produced by the inflammatory action on the vital fluid ; the red globules sink to the bottom before the fibrin has become sufficiently solid to entangle them in it, and thus the latter coheres more firmly and assumes its natural pale colour. But the nature of the change which gives rise to this is unknown. The buffy coat will appear in the last bleeding, which may occasion a fatal syncope ; it often appears from the mode of bleeding, and consequently is not to be relied upon.

Such are the general views which ought to guide us in the use of this powerful sedative, when employed with the view of producing a decided effect on the habit. Local blood-letting is useful as an auxiliary to general blood-letting ; it is better fitted to relieve in some cases of irritation in which general blood-letting would prove hurtful, and in cases of local inflammatory action. In chronic inflammation affecting the cavities of the body, local is more appropriate than general blood-letting, and this is true also respecting other partial affections. Blood may be locally abstracted either by *cupping* or by *leeches*.

Cupping is of very ancient date, and is performed by some of the rudest nations. A horn was perhaps the most ancient cupping instrument, and suction by the mouth of the operator the mode of exhaustion. This was indeed one of the two kinds described by Celsus*. The other was performed by a copper cup, in which linen was burnt to produce the vacuum, in the same manner as the French still use tow in their cupping glasses. The principle of the cupping glass is to produce a determination of blood to the scarified part, by removing from it the pressure of the atmosphere : much, therefore, depends on the exhaustion of the cup : if it be not sufficient, the determination is inadequate to produce a free flow of blood into the cup ; if it be too great, the edges of the

* De Re Medicina, lib. xi.

cup operate as a ligature, and check the flow towards the divided vessels.

When the quantity of blood to be locally abstracted is considerable, and especially if it be requisite to withdraw it quickly, so as to produce an immediate effect, then cupping is preferable to the application of leeches : but on some parts of the body, as, for example, the abdomen, cupping cannot be readily performed. From the manner in which the blood is taken by cupping, syncope rarely occurs, unless from fear ; consequently this method of abstracting blood is ill calculated to produce a sedative effect upon the habit ; although, in cases where the lancet has been previously employed, a degree of sinking occasionally occurs which is alarming. This, however, is less likely to happen than when leeches are employed ; as, from the nature of the incisions made by the scarificator, the bleeding is more under controul than it is from the orifices produced by the bites of leeches. The rings of which the body of the leech are composed seem to be a semi-cartilaginous substance, capable of expansion to nearly three times its natural magnitude ; thence the quantity of blood which a leech can draw is greatly disproportioned to its natural size. Mr. Kennedy has stated, on the authority of experiment, that it is equivalent to the weight of the animal : this, however, is no criterion of what is obtained ; for the blood continues to flow after the leech falls off ; and, by applying a poultice or warm water to the orifices, or a cupping glass over the place, a considerable quantity may be afterwards abstracted. It is a curious and still unexplained fact, that the blood taken into the body of a leech remains for two or three months uncoagulated and free from putridity : the only change it suffers is that of becoming deeper in colour, and a little thicker in consistency. When the animal is gorged with blood, it drops off ; and this usually occurs in ten or fifteen minutes : but occasionally it will remain affixed for a considerable time, as if from indolence ; but they are easily roused from this state by sprinkling them with a few drops of cold water. The ancients, when they wished to abstract a large quantity of blood with few leeches, snipped off their tails when they were in the act of sucking : the blood flows drop

by drop from the artificial opening, and the leech continues to suck. The same effect is produced by an incision made by a lancet near the tail of the animal when it is sucking*.

There are some circumstances connected with the application of leeches which require to be noticed. An erysipelatous inflammation sometimes follows their application, which has been referred to a peculiar irritable state of the skin of the patient; but which has been ascertained by M. Derheim to proceed from the sudden separation of the leech by force, causing the teeth to separate from the animal and remain in the wound. The leech should, therefore, always be permitted to drop off spontaneously.

Various means have been suggested to facilitate the application of leeches; the best and the simplest is to make the part clean and dry, and also to dry the leeches in a clean cloth; or if this fail, to scratch the surface of the skin with the point of a lancet, and to apply the leech on the spot moistened with blood. If the skin be much inflamed and

* It is curious that the circumstance of the leech dropping off when it is gorged, and yet thus continuing to suck if the blood be allowed to flow from it by a puncture, or cutting off the tail during the act of sucking, has never suggested the question—what causes the leech to drop off when it is gorged?—The usual reply which I have received to this question is that the leech has had enough; or that it drops from the uneasiness of distension. This, however, is not the case: it drops because it falls into a state of asphyxia, from want of respiration; and I found this opinion upon the following grounds. The respiratory organs of the leech are a number of vesicles in immediate contact with the lateral longitudinal vessels, small twigs of which communicate with these vesicles, so as to submit the blood to the action of the air. Now, although the leech can live for some days in oil and in the exhausted receiver of an air pump, yet, from an experiment made by Dr. Edwards, it is evident that the leech respire and consumes the oxygenous portion of the air; the inference from which is, that the animal, by filling these vesicles with air, can exist for some days without a fresh supply: but it by no means follows that they can exist if these vesicles be entirely emptied. My opinion, therefore, is that the animal continues capable of exerting the function of sucking as long as these vesicles contain a sufficiency of air for the respiration to be carried on; but, as the body becomes greatly distended with blood, the cavities of these vesicles are obliterated; no respiration can consequently take place; and, as in all animals that breathe by lungs, asphyxia occurs as soon as air ceases to be received into them, and, the muscular energy depending on volition being no longer exerted, the leech drops off. When the tail is punctured or is cut off during sucking, no asphyxia occurs, because the vesicles are not compressed, and therefore the leech continues to suck.

hot, a little tepid water should be poured into the water containing the leeches, before they are taken out of it to be applied; and this should also be done if it be requisite to apply them within the mouth, on the verge of the anus, or within the vagina. If sulphur be taken internally or if it be externally applied, leeches will not bite; neither will they bite if tobacco smoke, or vinegar in vapour, be diffused through the apartment of the patient.

When leeches are applied to soft parts, for instance, to the abdomen, it is truly astonishing how much blood sometimes is detracted; particularly when a poultice is applied over the bites, and the patient is kept warm in bed: to prevent, therefore, injurious symptoms of exhaustion from such a circumstance, the poultice should be frequently examined. This is more likely to occur in children than in adults; and in children it not unfrequently happens that the bleeding cannot be stopped without the encircling the orifice with a ligature. On this account, leeches should never be applied late at night on children; for as the application of leeches in infancy must be regarded as a species of general blood-letting, the precise number which will regulate not only the quantity, but be equivalent to rapidity in the detraction of the blood should be determined; but the bites should be instantly closed on observing that the system is brought under the influence of loss of blood.

By whatever means blood is abstracted, if the quantity be more than the constitution can bear to lose, morbid effects result, which require to be noticed. Thus the *delirium* which frequently occurs has in some instances continued, and has worn out the patient. The first or second bleeding may be well borne; but a repetition of it may produce sudden dissolution; the pulse suddenly falls, becomes a mere flutter, and the person rarely survives more than a few hours. Effusion into the ventricles is not an unfrequent consequence of an extreme degree of vascular exhaustion. Sometimes, when reaction occurs, it is feeble, and continues so, causing fainting on the slightest exertion, and sometimes terminating in sinking to a hazardous degree. In other cases the reaction produces symptoms resembling those of inflammation of the

membranes of the brain : as, for instance, hard beating pulse, particularly in the carotids ; throbbing in the head ; palpitation of the heart, and pulsation of the aorta. These symptoms are augmented by the smallest degree of bodily or mental exertion : and if another bleeding be resorted to, which has too frequently occurred from an idea that these symptoms depend on inflammation, immediate dissolution may take place. Instead of blood-letting, light cordials, a mild but nutritious diet, rest and quietude, should be enjoined.

Practical Employment of Sedatives.

All the sedatives which we have examined, with the exception of blood-letting, are powerful poisons : their employment, therefore, as remedial agents, require more than ordinary caution : but, when they are properly administered, and their effects carefully watched, they are possessed of powers that cannot be obtained from any other medicines. They are chiefly indicated in diseases of increased sensibility and irritability ; but they are also serviceable in some which cannot be classed with these. As the remedial effects of most of the substances described have been mentioned, I will confine my remarks chiefly to blood-letting.

In intermittent fevers Sedatives are not indicated, if we except blood-letting, which has been employed as the sole means of cure in these diseases by the older physicians. The practice partly arose from the mistaken notion that a morbid matter existed in the blood which it was necessary to evacuate—an opinion now justly exploded. Whatever may be the sources whence they originate, whether from the influence of simple aqueous vapour applied to the surface, whether from the decomposition of water and the lowering influence of hydrogen acting on the body through the nervous system, or from the effluvia arising from marshes, known by the name of Miasma, they are diseases connected with irritability and debility ; and, therefore, whatever tends to increase these states of the habit must favour the existence of the disease. If this opinion be correct, it must be obvious that the abstraction of blood is not to be indiscriminately employed in intermittents : indeed, when it has been resorted to, it has

frequently rendered them more obstinate than usual. It has also tended to induce other diseases, upon habits labouring under ague; such, for instance, as dropsy; and that state of plethora which indicates a greatly diminished vigour of body. Circumstances, however, may occur not only to permit, but to demand, the use of the lancet in intermittents. Thus, when the disease appears in spring, it is frequently modified by the inflammatory diathesis—a disposition of body which always prevails at that season, and requires blood-letting in the commencement of the attack. But, even under this state, the age, constitution, habits, and the situation of the patient, must be considered; for if a man, labouring under a vernal ague, and displaying that diathesis which authorizes blood-letting, live in a damp situation, he is much less able to bear the loss of blood than one living in a dry situation; and therefore this sedative remedy must be employed with caution.

The type of the intermittent, also, influences the propriety of blood-letting. Quotidians are more likely to require it than tertians, and these than quartans: but sometimes the condition of the air and the character of the prevailing epidemic forbid its employment, although it be apparently indicated. If the disease occur after long-continued rains, it not unfrequently assumes something of the typhoid type, and then blood-letting proves hurtful. If the intermittent, whatever be its type, have run on for a considerable time, the habit cannot fail to have suffered; and, consequently, the duration of the disease must also be taken into account, in determining the propriety of blood-letting. When it is proper, it is requisite to enquire in what stage of the disease it is likely to prove most beneficial. It has been employed both during the paroxysm and during the interval. Whilst the cold or the sweating stage is present, it should never be resorted to; for in the first the vital powers are depressed, and in the second they are exhausted. If, therefore, it be used during the paroxysm, it must be whilst the hot stage is present: but even then caution is requisite, as the over abstraction of blood at this time may induce a dangerous state of collapse.

In the interval it is seldom that symptoms occur which authorize the use of blood-letting. The symptoms indicating

the loss of blood are those of great excitement; a full, hard pulse; violent headache, with throbbing at the temples, and flushing of the face, continuing more or less during the whole interval. Those indicating it in the hot stage of the paroxysm are a quick, hard pulse, great headache, suffusion of the eyes, delirium, and great thirst. With respect to the quantity to be taken away, this must be determined by the power of the habit, indicated by tendency to, or freedom from, syncope when the patient is bled in the erect posture. As a general rule, however, blood-letting should be very sparingly employed in agues. The use of other sedatives is still more exceptionable. In making this remark, however, it is necessary to state that the bitter almond emulsion, which owes its properties to hydrocyanic acid, has been used successfully in intermittents, even in cases where the bark failed; and Dr. Brown Langrish used to cure agues with the distilled water of the *Prunus laurocerasus*.

If such a pure state of inflammatory fever as that designated under the name of Synocha by Dr. Cullen exist, there can be no question as to the propriety of abstracting blood: but, if continued fevers be generally of a typhoid character, many circumstances ought to be enquired into before blood-letting be employed; and the sum of medical opinion is against it. Not only the constitution of the patient, but the state of the atmosphere must be taken into account; for as inflammatory fevers sink into typhus, so this fever sometimes suddenly changes its character and displays an inflammatory type. Thus, in the British army in the Peninsula, typhus, in the hospital at Bilboa, while the atmosphere remained sultry and relaxing, assumed characters directly the reverse of those indicating venæsection: but as soon as the weather changed, and frost set in, the change of type, says Dr. Hennen, "pressed on our consideration the propriety of blood-letting. This was rendered obvious by the fact that spontaneous hæmorrhages, which formerly sunk the patient's strength, were now accompanied with obvious relief." In synochus, blood-letting is indicated in the early stage of the disease, and may be repeated according to the manner in which it is borne; but if the disease have run on for a few days, an irremediable

degree of exhaustion is likely to follow blood-letting: thence much judgment and address are requisite. As a general rule, the continued fevers of warm climates require the use of the lancet less than those of temperate climates; and those of cold climates more. In large towns, also, fevers require less the use of blood-letting than in the country; in damp situations than in dry; and in crowded hospitals than in private practice.

The nature of the exciting causes will also affect the consequences of blood-letting in continued fever. If inflammatory symptoms occur, topical blood-letting may be employed; and it should be laid down as an axiom, that recourse should never be had to general blood-letting unless symptoms strongly indicate the phlogistic diathesis. When the exciting cause of the fever is cold, the excitement is generally considerable, lasts longer, and the attack seems more to require bleeding than in the severer forms of continued fever. Epidemics differ not only in their nature, but in their consequences; and therefore require different treatment: in some, every circumstance seems to point out the propriety of blood-letting; yet it will prove injurious; and sometimes, when the propriety of the measure is less obvious, it is better borne and productive of benefit.

In pure inflammatory fever, blood-letting as a sedative may be employed at any period of the disease: in typhus, the commencement is the most proper period; but in mixed fevers it is difficult to fix the proper time, as the limits of the inflammatory portion of the disease and its opposite state are difficult to be fixed upon. As a general rule, however, the nearer to the commencement of the disease the bleeding takes place, the better, and the safer; the more precarious, and the greater the risk, the longer the attack has continued. In mixed fevers, the symptoms denoting the propriety of blood-letting are a frequent, full, hard pulse, increased thirst, a high temperature of the body, determination of blood to the head, and by delirium of the phrenitic kind: it is also indicated if any determination of the lungs exist, manifested by cough or difficulty of breathing, and to the abdomen by pain and tension: but, even when these symptoms are present, it may admit of a question how far the use of the lancet is ad-

visible in this fever. In fixing the quantity to be drawn, much care and discrimination are requisite: it must ever be borne in mind, that fever is an affection of the whole vascular and nervous systems, and, even when symptoms of high excitement display themselves, that still the disease differs from pure inflammation, and that syncope is more readily produced by blood-letting in this state than in pure inflammation. In inflammation, there is much less susceptibility of the nervous system, and larger abstractions of blood are borne in it with impunity; but, in the reaction of fever, stout men frequently faint on being bled even to a very moderate amount: nevertheless, when local inflammation is superinduced, the same individual will bear a larger quantity to be taken without fainting. There is, in fact, in this form of fever, a strict alliance between the degree of tolerance of loss of blood and the exigencies of the cure.

I have been more particular in my remarks upon fever, because blood-letting is the only direct sedative which is usually employed in that form of disease.

In the Phlegmasiæ, blood-letting constitutes the most important curative agent. Still, however, the abstraction of blood is to be resorted to with caution; for it is a well-known fact, that the moment the protecting influence of inflammation is gone or withdrawn, further blood-letting is in the highest degree dangerous. When the inflammation is extreme in violence or diffusion, the whole nervous system becomes severely affected; nevertheless, from the protecting influence of inflammation, general blood-letting is indicated, and it is well borne; but, after a certain time, the abstraction of blood exhausts the powers of the system, and sinking supervenes. Syncope does not at once subdue the reaction in severe inflammation; but it is subdued by repeated or excessive syncope: and in this respect inflammation of an active kind differs from fever, in which syncope at once subdues all the actions. A much larger quantity of blood may be also drawn with impunity in inflammation than in fever; but we must, at the same time, recollect what I have already mentioned, that the remote effects of excessive blood-letting are apt to supervene the moment the inflammatory action is subdued. No

mistake is so dangerous as to bleed after the symptoms of inflammation have been subdued with the view of preventing a recurrence of them.

In erysipelatous inflammation, the propriety of employing blood-letting as a general Sedative depends on the type of the attending fever. If it be of the inflammatory kind, blood-letting is indicated; but not to the extent as in acute inflammation. Topical bleeding, however, which was formerly deprecated, has of late years been found to be highly serviceable. If the attending fever be of the typhoid kind, it is unnecessary to say that blood-letting would be injurious.

In ophthalmia, general blood-letting is not frequently required; topical bleeding with leeches, if early resorted to, being sufficient to subdue the inflammation: but, when this is deep seated, with swelling, intense pain, and intolerance of light: when the pulse is full and hard, not only venæsection, but arteriotomy, so as to induce repeated syncope, will be found necessary. If local bleeding only be indicated, and the inflammation have run on for some days, cupping, as it abstracts the blood more suddenly than leeches, is to be preferred. Scarification of the inflamed vessels, however, is better than either. When the pain is acute, I have seen much relief obtained from the topical application of the hydrocyanic acid, very largely diluted.

In Cynanche Trachealis, Croup, blood-letting, carried at once to syncope, in the very commencement of the disease, often arrests its progress at once. Some practitioners draw the blood from the jugular vein, others prefer cupping; but the principle is the same; by a sudden abstraction of blood, to produce a powerful *sedative* effect on the arterial system, and thus subdue the local inflammation. I am rather surprised that in this case the inhalation of largely diluted carburetted hydrogen gas has not been employed in aid of the lancet.

The term *Pneumonia* is generic of all the inflammatory attacks of the thoracic viscera; and, in these, the general abstraction of blood is more or less called for: in inflammation of the substance of the lungs, the blood-letting should be prompt, copious, and repeated: but it should be confined to

the early stages of the disease, the type of the accompanying fever often declining into typhus in the advanced stage of the disease. It is in this disease that the extent of the quantity of blood to be lost can neither be foreseen nor indeed ordered by the physician, who, in every case, should witness the operation and regulate the quantity by its effects: as an average quantity, in an adult, less than from thirty to thirty-five ounces will seldom prove serviceable. In that state of pulmonary inflammation, which has been termed bastard peripneumony, *Peripneumonia notha*, blood-letting is generally regarded as hurtful. It frequently occurs in broken-down habits; and in those addicted to the abuse of spirituous liquors. Some discrimination is requisite to recognize the disease in the commencement. It differs from pneumonia in the character of the cough, which is short, with copious expectoration, and little or no fever. As it proceeds, the cough increases in violence, the breathing becomes more difficult, the expectoration less, whilst the face assumes a livid hue, and the air tubes of the lungs are choaked up with a frothy mucus, and suffocation ensues. It is evident that, in such a condition of the lungs, blood-letting, or Sedatives of any description, would prove hurtful; on the contrary, stimulant expectorants, ammonia, and blistering, are indicated. Pneumonia, attacking old people, is very apt to sink into this state; and the same result may follow the incautious and undue abstraction of blood in pneumonia.

In both pneumonia and in inflammation of the serous membrane of the chest, if the pain be considerable, there can be no doubt of the necessity of copious blood-letting; but the absence of pain does not denote the contrary. At one time the medical world was divided in opinion whether the blood should be taken from the pained side or the opposite: and no instance of the effects of controversy in blinding the judgment is more striking than this dispute: the Emperor Charles IX was appealed to; but, before he delivered his judgment, he was bled for pleurisy and died; and his death was ascribed to the blood having been drawn from the wrong side. The controversy ran still higher; and ended, as all such disputes usually do, without either party being con-

vinced ; and both remaining a mark for the finger of derision in future ages :—*Sanin ? creta an carbone notandi ?*

In pneumonic inflammation, also, we are to be guided in determining the propriety of venæsection by the period of the disease. It was formerly an opinion that, after four days, peripneumony could not terminate in resolution ; but more correct observation has exposed this error : nevertheless, venæsection cannot be too early employed ; and a small quantity of blood, such as merely to bring on a slight tendency to syncope when the patient is in the erect posture, if taken within the first twelve hours, will often prevent the necessity of further blood-letting. The abstraction of blood, however, is not to be confined to any period ; it is to be regulated solely by the symptoms : but we must always bear in mind that there is more to be apprehended from the disease than from the lancet. I have said that the average quantity of blood to be taken at once is about thirty or thirty-five ounces : I have seen this quantity abstracted every eight hours, until 140 ounces were lost within forty-eight hours with decided advantage. Much also depends on the rapid abstraction of the blood : in this species of inflammation, therefore, more than in any other, a large orifice, with the erect posture, is never to be dispensed with. Such are the advantages of this sedative agent in pneumonia : it is proper to look at the bad effects likely to follow its abuse. The first bad effect of excessive blood-letting in this disease, is interruption of expectoration, inducing effusion into the lungs, and causing either suffocation or hydrothorax. In the present day, such an effect is not likely to occur ; the habit of following a full bleeding with a large dose of calomel and opium superseding the necessity of its frequent repetition. These remarks on pneumonia may be considered too much in detail ; but, as the principle upon which we must proceed in this disease is applicable to all the other phlegmasiæ, I have ventured to enter a little more into the practical treatment of these diseases than would otherwise have been requisite. The use of the unrespirable gases in the phlegmasiæ has been, perhaps, too little attended to : in many respects they might prove useful,

from the facility with which they can be applied to the seat of the inflammation, either when it is external, or confined to the pulmonary system of vessels.

In active hæmorrhages, Sedatives are indicated, and, of course, blood-letting. During the flowing of the hæmorrhage, although blood-letting be often resorted to, it is obviously unnecessary, as the hæmorrhage will cease as soon as the quantity of blood lost brings down the plethoric state which induced it: thence it is generally more useful to bleed in the interval, so as to anticipate the attack; and, at this time, the bleeding should be carried to syncope. If, during the hæmorrhagic flow, blood-letting be at all advisable, the same rule should govern the mode of abstracting the blood: during the state of syncope, the hæmorrhage stops, and time is afforded for a coagulum to form in the ruptured orifice of the vessel—the method which Nature adopts to check these discharges. In passive hæmorrhages, blood-letting is contraindicated; and this is also true of all other Sedatives.

In phthisis, blood-letting has been much employed. In the inflammatory stage of the disease, blood-letting is our principal remedial agent. It must be early employed; the object being to diminish vascular action: but, in this deplorable malady, the symptoms are not always so obvious as to lead to decisive measures; the inflammatory action steals on insidiously; and the disease, when it is only expected, has already established itself in the frame. Still, if suppuration have not taken place, the lancet may prove useful; but the utmost discrimination is requisite in directing its employment. In the second stage of the disease, when tubercles are already in a suppurating state, candour forces me to say, that no method of treatment hitherto suggested has availed: but it is an undoubted fact, that much relief has been afforded by small and frequently repeated venæsections. The quantity taken at a time should not exceed a few ounces; seldom more than three. Phthisical patients, even after hectic shews itself, bear such bleedings well; and instances are recorded in which they have been bled two hundred times in a few months. What advantages are derived, except transitory ease to the feelings

of the patient, it would be difficult to conceive; the same termination takes place as awaits all those who are subjects of this relentless disease. Carburetted hydrogen gas, mixed with common air, in the proportion of $\frac{1}{20}$ to $\frac{1}{30}$ in 100 of air, has been found to afford immediate relief in the hectic of phthisis; diminishing the sense of uneasiness, promoting sleep, and abating the frequency of expectoration: but the strength fails.

I have seen no case of dysentery in which it has been necessary to bleed to any considerable extent: in this affection some of the other sedatives, especially the hydrocyanic acid, are more likely to prove beneficial than the lancet.

Spasmodic and convulsive diseases generally depend on increased irritability; and, consequently, whatever favours debility is to be avoided. They are sometimes, however, complicated with an inflammatory diathesis; and, in this case, blood-letting is not to be neglected: but it is difficult to draw the line between these two states. When there is a determination to particular parts, although the phlogistic diathesis be not present, cupping and leeches may be proper.

In apoplexy, the lancet is resorted to during the attack; and also in the interval, to prevent the recurrence of the attack, from the idea of congestion or effusion of blood within the cranium: but this is not always the case; and apoplexy may proceed from causes depressing the powers of life, without the presence of actual plethora. When a state of plethora really exists, with an evident determination to the head, blood-letting cannot be dispensed with: but when the disease occurs in advanced life, in debilitated habits, and without much determination, Excitants are more likely to prove useful than Sedatives. But, even in old age, and in weak people, if determination to the head be evident, topical blood-letting will be useful.

In mania, the general use of the lancet has produced much mischief. It is true, that mania is accompanied with the most violent excitement: but in no case is this state so rapidly followed by collapse. How far the employment of other sedatives may be safely proceeded with in these cases is still a question for experience to decide.

SECTION IV.

REFRIGERANTS.—MEDICAMENTA REFRIGERANTIA.

Syn.—*Medicamenta temperantia.*

That there exist substances which diminish the morbid heat of the body is a well-established truth. The expression, cooling medicines, is not devoid of meaning, but implies a fact which has been acted upon, in prescribing for diseases, from the earliest periods of the history of the medical profession. But, although this refrigerant power has been acknowledged to exist in many substances, yet no very satisfactory explanation of the phenomenon which follows their administration has yet been offered. It would be a waste of time to mention the absurd hypotheses that have been advanced on this subject up to the time of Dr. Cullen, whose reasoning on the operation of Refrigerants is too obscure and hypothetical to merit attention, and is at complete variance with the usual soundness of his remarks.

The latest theory is that of Dr. John Murray, who has endeavoured to explain the operation of Refrigerants on chemical principles. He sets out by considering as an established fact that animal heat depends on the consumption of oxygen in the lungs, and that this is greatly influenced by the nature of the food and other ingesta received into the stomach; that, when these consist of substances which contain a small proportion of oxygen, the consumption by the lungs is increased, and consequently the animal temperature is augmented; but, when the ingesta contain much oxygen, especially in a loose state of combination, then an opposite effect takes place in the lungs. This hypothesis is apparently supported by a fact observed by Mr. Spalding; namely, that he consumed the oxygen of the air in his diving bell in a much shorter space of time if he used an animal diet or drank spirituous liquors than when his nutriment was solely farinaceous matter. The hypothesis of Dr. Murray is founded on the presumption of the truth of the theory of Dr. Crawford, that

the arteries in the lungs absorb the caloric liberated there, in the process of respiration, and, owing to their great capacity for caloric, they instantly render it latent, in which state it remains until the subsequent conversion of the arterial into venous blood, when the heat is liberated equally through the system. Beautiful as this theory is, the difference of capacity of arterial and venous blood is certainly insufficient to account for the heat of the body; and subsequent enquiries have enabled us to explain the augmentation of animal temperature on different principles. Yet there are many facts which may be regarded as demonstrating the truth of Dr. Crawford's opinions. The size of the lungs and the quantity of blood which passes through them are in proportion to the temperature of the animals. Thus, the capacity of the lungs is greatest in birds, which have the highest temperature among animals; and the temperature, in the same animal, is always reduced when any circumstance lessens the free action of the lungs and prevents the consumption of oxygen. In hybernating animals, the temperature diminishes as respiration is suspended; and it rises with the return and the progress of respiration. M. Le Gallois, also, ascertained by experiment that, when less oxygen is consumed than in natural breathing, the temperature of the body always falls, and this exactly in the ratio of the quantity of oxygen consumed. It would be presumptuous in me to deny the accuracy of these experiments; but they can be explained on other principles. Thus, if we admit that nervous energy is the cause of animal heat, we can readily explain why the heat should be in the ratio of the size of the lungs, by supposing that, the nervous energy being greater in these animals, the secretions must proceed more actively than in the colder-blooded animals; and, as the blood must thus become more carbonized, a greater extent of surface in the lungs is required to carry off the carbon by the medium of the oxygen of the respired air. The facts, also, which tend to prove that the temperature of parts, and consequently that of the entire body, is regulated by the nervous energy, are as numerous and as satisfactory as

those which support the doctrine of Crawford. Sir E. Home ascertained that, by dividing the nerves going to a growing antler of a stag, the temperature fell immediately several degrees; and, although after a few days it again rose to a degree higher than in the other antler, yet, this may have depended upon circumstances of which we have not been made aware; and it does not invalidate the influence of the nervous energy, or the fact that the temperature of a part is greatly regulated by the state of the nerves. In paralysis, the heat of the limb falls, and yet, in many cases, the paralysis is confined to the sensibility of the limb, and the state of the local circulation is not commensurate with the reduced temperature. From these facts it appears that our ideas are still imperfect respecting the source of animal temperature. The most important experiments on the subject are those of Mr. Brodie. He found that the action of the heart can be maintained by artificial respiration after the brain is removed, and that, although the blood undergoes its ordinary changes, yet that animals thus treated cool rapidly. I cannot help remarking, that these experiments prove that no consolidation of oxygen occurs during respiration; for this would necessarily evolve heat: on the contrary, however, "when the inspired air is colder than the natural temperature of the animal, the effect of respiration is not to generate but to diminish animal heat." When the functions of the brain are suspended, the power of generating animal heat is also suspended; although, during this period, by means of artificial respiration, the same quantity of oxygen is consumed, and the same quantity of carbonic acid formed, as in natural respiration under ordinary circumstances. We cannot, therefore, refer animal heat solely to the chemical changes going on in the lungs.

The experiments by which Mr. Brodie established these facts were made on rabbits, in which the functions of the brain were suspended by dividing the spinal marrow. "It may perhaps be urged," says that ingenious physiologist, "that, in these experiments, the secretions had nearly, if not entirely, ceased: it is probable that the other changes which take place in the capillary vessels had ceased also, and that,

although the action of the air on the blood might have been the same as under ordinary circumstances, yet there might not have been the same alteration in the specific heat of this fluid as it flowed from the arteries into the veins. But, on this supposition, if the theory of Dr. Crawford be admitted as correct, there must have been a gradual but enormous accumulation of latent heat in the blood, which we cannot suppose to have taken place without its nature having been entirely altered. If the blood undergo the usual change in the capillary system of the lungs, it is probable that it must undergo the usual change in the capillary system of the greater circulation also, since these changes are obviously dependent on and connected with each other." In the experiments of Mr. Brodie, the blood in the aorta and pulmonary veins was not more florid, and that in the vena cava and the pulmonary artery was not less dark-coloured, than under ordinary circumstances.

These conclusions of Mr. Brodie are further verified by the fact that, when the axillary plexus of nerves on one side is crushed, as was observed in an accident which came under the care of Mr. Earle, the paralyzed limb of that side is of a lower temperature than the opposite limb: and, in general, paralyzed limbs are more easily affected by external heat and cold than sound limbs; whilst increased nervous action is always accompanied by increase of temperature.

From a consideration of the foregoing facts we may affirm, that animal heat is a vital process, depending on the integrity of the nervous system. It is true that the stimulus of arterial blood is necessary for the excitement of the brain and nerves, and consequently for the proper development of animal heat: respiration, therefore, is so far essential in the production of animal temperature, that it produces that change in the blood without which the brain would lose its energy, and the heat of the system be necessarily greatly lowered. Under the present opinion, that carbon is converted into carbonic acid in the lungs, and that heat must necessarily be evolved by the act of the oxygen combining with the carbon, we must still admit that something is due to this, and adopt so far Dr. Crawford's theory; but that animal heat is rather

to be ascribed to vital energy than to chemical phenomena, cannot be denied. This opinion received great support from some experiments of Dulong, who, in 1823, repeated those of Lavoisier and Delaplace, with the view of ascertaining whether the quantity of caloric, developed by the oxygen which disappears in respiration, be equivalent to the quantity given out by the body. He found that, in carnivorous animals, it is equal to 49 and 55 parts in 100 of the heat generated by the whole body during the same interval of time; and, in phytivorous animals, to betwixt 65 and 75 parts; and that the whole quantity of caloric and water together is equivalent to 69 and 80 parts only: thence that the animal heat is greater than can be accounted for by the fixing of oxygen during respiration.

In stating my opinion in favour of the conclusions drawn by Mr. Brodie from his experiments, it is only justice to mention the opinion of M. Gallois, that, owing to the nature of artificial respiration, the temperature may fall, and the animal actually be killed by cold, even though every part remain uninjured. The air introduced in artificial respiration does not rush into the pulmonary cells, because they are in the state of vacuum, but is propelled into them forcibly; the consequence of which is the formation of a large quantity of frothy mucus, which both prevents the air coming in contact with the sides of the air cells, and by its evaporation tends to cool the body. A more forcible argument on the same side is found in the facts, that acephalus *foetuses* maintain their temperature during the few days that they live; and that vegetables, which have no nervous system, preserve a certain degree of temperature, and resist the influence of external cold. Such are the contending opinions that obstruct our efforts to arrive at truth: the most probable state of the case is, that both opinions are to a certain extent true; that animal heat is influenced by the state of the nervous system, and in part also by chemical changes occurring in the lungs.

Such being the sources of animal heat, the theory of Dr. John Murray can be regarded only in the light of an ingenious hypothesis. In what manner, then, it may be asked,

do refrigerants operate? It is, under all circumstances, more easy to destroy than to build up: the weak parts of the hypothesis of Dr. Murray are obvious; but it is difficult to form a less objectionable theory. We may, however, endeavour to approach to something like an explanation of the mode in which refrigerants operate. If we reflect upon the action of those substances which produce a refrigerant effect when applied to the surface of the body—for example, diluted acids, salts in a state of solution, and cold water or ice—we may form some idea of the manner in which they operate when taken into the stomach. The term cold, as applied to the surface, is the common method of expressing the fact of the abstraction of caloric. By whatever means this is effected, the capillaries of the surface have their activity immediately diminished; and, as these form a part of the whole vascular structure of the body, their activity cannot be materially lessened without that of the whole body being also influenced; thence the vigour of the heart and arteries is materially diminished by the abstraction of caloric from the capillary branches of the system. The consequence of this is immediately felt on the respiration; the blood does not undergo its necessary change; black blood is conveyed to the brain; and, impeding its functions, a state approaching that of paralysis of the nervous system ensues; so that torpor of all the functions depending on the energy of the brain must necessarily follow. Now, let us suppose, and the supposition is not unreasonable, that something resembling this effect on the surface takes place when the same kind of substance is introduced into the stomach; and recollecting the sympathy existing between the stomach and the skin, we may readily admit the possibility of the same general influence over the whole system being equally experienced in the one case as in the other. This opinion receives some support from the fact, that neutral salts—for example, nitre—produces its most powerful effect as a general refrigerant when it is swallowed at the moment of its solution; for, when taken after it has been some time dissolved, it operates as an excitant. The sensation of cold, therefore, which nitre, during solution, causes in the stomach, may be regarded as equivalent to the partial abstraction of stimulus; and this being

extended to the heart and arterial system, produces a reduction of action, which is followed by a sensation of cold over the whole body.

We thus advance one step towards an explanation of the action of refrigerants; yet it is a small step only: but although this theory is not generally admissible, yet it is important to know that, in a practical point of view, any theory is of little value, and that it is more useful to attend to the phenomena connected with the operation of those articles which experience has taught us exert a refrigerant influence, than to theorize on their action on the living system.

1. *Effects of Refrigerants upon the Digestive Organs.*—In the healthy state of the stomach, little impression is made upon it by medicines of this class; but, when it is in a more irritable condition, refrigerants, particularly the vegetable acids, allay the sensations of heat, nausea, thirst, and general uneasiness, which irritation produces in it. In a more extensive state of disease, however, when ulceration or cancer exists, refrigerants tend rather to increase than to allay the sufferings of the patient.

2.—*upon the Circulating and Respiratory Organs.*—Most of the substances employed as refrigerants are taken into the circulation; but, in the healthy condition of the habit, they cause no evident change in the action of the vessels, neither diminishing nor augmenting the force or the frequency of the action of the heart, nor that of the larger blood vessels, nor even of the capillaries. But in a state of excitement, they moderate arterial action, and relax the tension of the pulse; and their effect upon the capillaries is especially manifested by the diminished temperature which follows their administration. This refrigerant influence is so decided, that those labouring under fever display an instinctive desire for acidulated fluids, which keeps pace with the degree of the temperature of the body.

In the same manner, refrigerants do not sensibly affect the respiratory function in health; but, in the febrile state of the habit, the influence which they exert on the circulation is necessarily communicated to the lungs. In the diseased state of these organs, many refrigerants, particularly the vegetable

acids, augment cough and oppress the breathing, if administered before the inflammatory action is lowered and the morbid susceptibility of the mucous membrane is diminished.

3.—*upon the Secerning System.*—The action of refrigerants upon the secreting organs seems to be confined to the kidneys: the quantity of urine is greatly augmented; but this seems to be altogether independent of the refrigerant effect of the substances belonging to this class of medicinal agents.

4.—*upon the Nervous System.*—Although little effect be produced on the nerves by the introduction of refrigerants into the habit, in the healthy condition of the body, yet, in affections of the spinal cord, the whole of the organic tissues are rendered more susceptible of impression by the administration of the vegetable acids. I once witnessed a remarkable illustration of this fact in a person who was labouring under subacute inflammation of the spinal theca. Whenever he swallowed an ordinary effervescing draught, he immediately suffered from a sensation of pricking over the surface, the skin became so sensitive as scarcely to admit of being touched, and the whole habit restless and uneasy. This effect might be ascribed to idiosyncrasy, were it confined to particular individuals, which is not the case.

Notwithstanding these effects of refrigerants upon particular organs, they operate generally as atonics; and the cooling effect which they produce, although first exerted solely upon the nerves of sensation, yet is soon extended to the whole of the system. Refrigerants may be regarded, therefore, as operating either on the organic functions or on the sensibility of the body.

TABLE OF REFRIGERANTS.

A. REFRIGERANTS OPERATING ON THE ORGANIC FUNCTIONS.

* *Organic Products.*

a.—VEGETABLE ACIDS—

Oxygen combined with Compound Radicals, forming

Acetic Acid ;
 Oxalic Acid ;
 Citric Acid ;
 Tartaric Acid ;
 Malic Acid.

* * *Inorganic Substances.*

b.—NITRATE OF POTASSA.

c.—BIBORATE OF SODA.

B. REFRIGERANTS OPERATING ON THE SENSIBILITY.

d.—COOL AIR.

e.—ICE—COLD WATER.

f.—EVAPORATING LOTIONS.

ORGANIC SUBSTANCES WHICH OPERATE AS REFRIGERANTS.

a. VEGETABLE ACIDS.

1. *Acetic Acid.* This acid is a very abundant production of nature, being found in the sap of all plants, either in a free or in a combined state. It approaches nearer than any other of the vegetable acids to the state of the primary vegetable products ; namely, gum, fecula, sugar, and ligneous matter, all of which, by a small modification of their components, form acetic acid. This analogy, more or less complete, as De Candolle has well remarked, tends on the one hand to explain the facility of its formation, and perhaps on the other to demonstrate that acidification is a phenomenon different

from that of oxygenation as manifested in the formation of the mineral acids*.

Acetic acid is prepared for medicinal use by submitting vegetable matter to destructive distillation, or by subjecting it to fermentation. In the former process, it is procured by distilling wood in large cast iron cylinders. It comes over mixed with *tar* and volatile oil; in which state it is combined with chalk to form an acetate, which is afterwards decomposed by sulphate of soda, and thus converted into acetate of soda, which is again decomposed by sulphuric acid, and acetic acid and sulphate of soda procured. The acid in this state is termed pyroligneous acid; it possesses all the properties of pure acetic acid.

Common vinegar is prepared by fermentation from wine, or infusion of malt, or sugar and water, or any substance containing much saccharine matter. In this state, it is more or less coloured, and contains mucilage and gluten; and that sold in the shops contains also a small proportion of sulphuric acid, the law permitting the maker to mix with it a thousandth of its weight of that acid. To free vinegar from impurities, it is distilled in clean glass vessels; and the first eighth part which comes over being rejected, the six parts which follow constitute the *distilled vinegar* of the Pharmacopœias. This is a colourless, limpid, volatile, slightly pungent fluid, having a refreshing odour, and containing five per cent. of acetic acid. Sixteen parts of pure pyroligneous acid, of a gravity of 1.046, mixed with eighty-four parts of water, form an acid of the same strength and quality as distilled vinegar.

Distilled vinegar is sometimes adulterated with sulphuric or with muriatic acid: the presence of the first is detected by muriate of baryta; that of the second by nitrate of silver. It may, also, contain salts of copper, tin, or lead: the copper is detected by ferro-cyanate of potassa or by ammonia; the tin by nitro-muriate of gold; and the lead by sulphuretted hydrogen.

The pure anhydrous acetic acid contained in common vinegar and in distilled vinegar consists of

* Physiologie Végétale, par A. P. De Candolle, t. i, p. 312.

		Berzelius.	Prout*.	Gay-Lussac.
4 prop. of Carbon	$(6 \times 4) = 24$, or	46.83	47.05	50.224
3 ——— Hydrogen	$(1 \times 3) = 3$	6.35	6.87	5.629
3 ——— Oxygen	$(8 \times 3) = 24$	46.82	47.08	44.147
	Equiv. 51	100.00	100.00	100.00

When 'adulterated with water, the quantity is denoted by the specific gravity of the vinegar; that of the distilled vinegar of the Pharmacopœias is 1.0036.

For administration as a refrigerant, vinegar or distilled vinegar is farther diluted with water or any vegetable demulcent fluid. It is a refreshing beverage; but, owing to the more agreeable qualities of the other vegetable acids, it is seldom administered. When taken, properly diluted, in a febrile state of the habit, the pulse becomes slower, the animal temperature is lowered, and the secretions are improved. It is used topically as a gargle in sore throats. In hæmorrhages, the cold feeling which it produces on the skin is sympathetically extended to the rest of the habit. I have been much in the habit of ordering it in the hectic fever of phthisis, with seeming advantage, both externally applied and internally administered, in doses of half a fluid ounce, three or four times a day. It should be recollected that, if opium be prescribed in conjunction with it, the activity of the narcotic is greatly augmented by such a combination. Its external application as a refrigerant lotion is applicable to every case in which the skin is preternaturally hot, when no peculiar idiosyncrasy forbids its employment.

2. *Oxalic Acid*.—This acid was formerly much employed as a refrigerant, in the state of the binoxalate, contained in the leaves of the *Oxalis Acetocella*, or wood sorrel, an elegant little plant belonging to the natural order Oxalideæ, found in woods and moist shady places, flowering in April and May†.

The leaves, by simple expression, yield a juice which contains binoxalate of potassa: it is contained also in the expressed juice of the common sorrel, *Rumex Acetosa*, a

* Dr. Prout states that the oxygen and hydrogen of this acid are in the exact proportions to form water. Phil. Trans. 1827, p. 355.

† Woodville's Med. Bot. third edition p. 563, pl. 201.

plant belonging to the natural order Polygoneæ. But the facility with which the binoxalate is artificially prepared has set aside altogether the use of these plants. Except for the purpose of making whey, by boiling the leaves of the wood sorrel with milk and straining the decoction, this acid is seldom therapeutically employed.

The oxalic acid, the base of the binoxalate, is in various states of combination in the rhizomes and bulbs of tormentil, fennel, valerian, Florentine iris, ginger, turmeric, and squill, besides those of many plants which are not medicinal: it is also found in the barks of Simarouba, Cascarilla, and *Canella alba*, and in the state of the binoxalate, in various parts of the plant, in *Oxalis Acetosella*, *Rumex Acetosa*, *Rheum palmatum*, and in combination with soda in *Sal-sola soda*. It is generally procured by acting upon sugar, starch, gum, and many other vegetable substances, by nitric acid. In this process, a part of the nitric acid is decomposed and converted into oxygen and deutoxide of nitrogen: the sugar is also decomposed, and carbonic acid, water, and oxalic acid are formed. It is probable that the sugar, which is a compound of carbon, hydrogen, and oxygen, is deprived of all its hydrogen and part of its carbon by the oxygen derived from the decomposed nitric acid.

The crystals, purified by repeated solution and crystallization, are slender, white, semitransparent, flattened, four-sided prisms, terminated by dihedral summits. They impress an agreeable, acid taste on the tongue, and communicate a sensible acidity to 2633 parts of water. They slightly effloresce in dry air, dissolve in eleven times their weight of cold water, and without any limit in boiling water. They contain forty-eight per cent. of water of crystallization, which can be expelled by heat, and the acid sublimed without decomposing it. It is distinguished by forming a white precipitate with lime water, which is insoluble in an excess of the acid.

Although oxalic acid is readily sublimed unaltered, yet it is decomposed by heat and resolved into carbonic acid and carburetted hydrogen gases. The constituents of this acid are

		Gay-Lussac.	Prout.	Berzelius.
Carbon	2 prop. = 12, or	26.566	19.04	33.78
Oxygen	3 prop. = 24	70.689	76.21	66.22
Hydrogen		2.745	4.75	0.0
Equivalent	36	100.000	100.00	100.00

The binoxalate is as easily decomposed as the oxalic acid. Owing to the high state of oxidizement of the acid which is its base, no charcoal remains. In prescribing the binoxalate as a refrigerant, it must be borne in mind that neither salts of lime nor of lead can be prescribed in conjunction with it.

3. *Tartaric Acid*.—This acid is formed by the hand of Nature in many fruits; but seldom in an uncombined state, being usually conjoined with potassa or lime. It is, however, obtained from one only of these fruits, the tamarind, the fruit of the *Tamarindus Indica*, a plant belonging to the natural order Leguminosæ*; a native of both the East and West Indies. The acid contained in the tamarind, the Tartaric, is prepared artificially by decomposing the bitartrate of potassa with chalk, so as to form a tartrate of lime, and next decomposing this tartrate with sulphuric acid, which, uniting with the lime and forming an insoluble salt, sets the acid free. It is only, however, with the excess of acid in the bitartrate that the lime combines, the tartrate of potassa remaining in the solution, whilst the tartrate of lime is precipitated. In the formula of the London College, thirty ounces of bitartrate of potassa are ordered to be decomposed by twelve ounces of prepared chalk. Now the proportion of excess of acid in this quantity of acid is ten ounces and a half; but, owing to loss in the manipulation, this quantity is never procured. Tartaric acid readily crystallizes in colourless, inodorous, prismatic crystals, the primitive form of which is an oblique or right rhombic prism. The crystal of Tartaric acid is persistent in the air: soluble in five times its weight of water at 60°, and in a much smaller quantity of boiling water. It is also soluble in alcohol. This solution, when largely diluted, has a very agreeable, acid taste, and reddens strongly the tincture of litmus. The aqueous solution soon becomes mouldy: it is distin-

* Woodville's Med. Bot. third edition, p. 448, pl. 161.

guished, in this state, from all other acids by forming a white precipitate when mixed with any salt of potassa, and from oxalic acid by the white precipitate which it forms with lime-water dissolving readily in an excess of the acid.

Tartaric acid, in its crystallized state, is a compound of 88.16 of the dry or anhydrous acid and 11.84 of water, in 100 parts. The constituents of the anhydrous acid are

		Berzelius.	Gay-Lussac.	Prout.
Carbon	4 prop. = 24 or	35.980	24.050	32.0
Oxygen	5 = 40	60.213	69.321	64.0
Hydrogen	2 = 2	3.807	6.629	4.0
Equivalent	66	100.000	100.000	100.0

As it decomposes the alkaline carbonates and forms tartrates, it cannot be prescribed in combination with these, unless we are desirous of forming tartrates and extricating the carbonic acid. If muriate of baryta be decomposed and a white insoluble precipitate thrown down, when that salt is added in solution to a solution of tartaric acid, it indicates the presence of sulphuric acid.

This acid, both in its free state, if largely diluted with water, and also in the state in which it is contained in the tamarind, is a useful and agreeable refrigerant. It is employed as ordinary beverage in febrile affections, especially those of a bilious kind; and its utility in nausea, vomiting, and even diarrhœa, is well established. It operates chiefly upon the cerebro-spinal system.

4. *Citric Acid* is abundantly prepared by the hand of Nature in the fruit of the lemon tree, *Citrus Medica*, and that of the orange, *Citrus Aurantium*, in gooseberries, wortleberries, the bird cherry, dulcamara berries, in heps, and in several other acidulous fruits; but in all it is combined with malic acid, mucilage, and sugar.

Citric acid is prepared from lemon juice by adding prepared chalk to it, so as to form a citrate of lime, and then decomposing this with sulphuric acid. The insoluble sulphate of lime is separated by the filter; and the citric acid, remaining in solution, is obtained by crystallization in the due evaporation of the fluid which passes the filter. Forty parts of strong sulphuric acid, diluted with ten times their weight of water,

are requisite to decompose eighty-six parts of citrate of lime. To obtain the crystals quite pure, they should be dissolved and recrystallized. One hundred and sixty pounds of good lemon juice yield $\frac{3}{4}$ of pure crystallized acid.

Crystallized citric acid is colourless, inodorous, transparent, intensely but agreeably acid, soluble in its own weight of cold water at 60° Faht. and in half its weight of boiling water. It is also soluble in alcohol. By exposure to damp air the crystals absorb moisture, and the aqueous solution becomes mouldy by keeping. The crystals when exposed to heat are decomposed before all the water of crystallization is driven off. In its crystallized state this acid consists of dry or anhydrous acid 76.32, + water 23.68, in 100 parts. The constituents of the anhydrous acid are

				Berzelius. Gay-Lussac. Prout.		
Carbon	4 prop. $(6 \times 4) = 24$	or 41.309	33.801	34.28		
Hydrogen	2 ——— $(1 \times 2) = 2$	3.800	6.330	4.75		
Oxygen	4 ——— $(8 \times 4) = 32$	54.891	59.869	60.97		
Equivalent		58	100.000*	100.000	100.00	

Nine drachms of these crystals dissolved in f̄xxii of distilled water afford a solution equal in acidity to recent lemon juice: gr. xv of the crystals in solution saturate a scruple of carbonate of potassa; and gr. xxvi a scruple of subcarbonate of ammonia.

Citric acid in solution is distinguished from tartaric acid by not rendering lime water turbid, unless it be in excess, and by not forming insoluble precipitates with salts of potassa. It is, however, in its crystallized state often adulterated with tartaric acid, which is easily detected by saturating the solution with carbonate of potassa; or, if the adulteration be sulphate of potassa, by testing the solution with muriate of baryta.

Citric acid is the best of the vegetable acids which are employed as refrigerants. The uncombined acid, however, is less grateful than the recent lemon juice; and fever patients are particularly sensible of this, when it is employed to saturate the carbonate of potassa, or of ammonia, in forming the

* Its composition is so near that of sugar as to lead to the supposition that it is transformed into sugar as the fruit containing it ripens.

common effervescing draught for checking vomiting. Largely diluted with water and slightly sweetened with any agreeable syrup, it forms a useful and most agreeable drink in fevers, allaying heat and irritation, and reducing the pulse.

5. *Malic Acid*.—This acid is most abundantly supplied by the hand of Nature: it is found in almost all the fleshy fruits; for example, those of the orders Pomaceæ, Amygdalæ, and Myrtaceæ. Grapes, currants, gooseberries, strawberries, elderberries, the fruit of the service tree, *Sorbus aucuparia*, and many other fruits, contain it. It is generally found in combination with citric acid, and is most abundant in the fruits, which contain it, before they are perfectly ripe. It forms, also, in combination with lime, a component in the juice of the *Sempervivum tectorum*, and several of the species of *Sedum*: and exists in Labdanum, and in *Cocculus Indicus**.

When obtained in a separate state, malic acid is deliquescent, crystallizing with great difficulty; and, in its aqueous solution, is decomposed by keeping. Its crystals are colourless, mammillary, pleasantly acid, and soluble both in water and alcohol. One hundred parts of anhydrous malic acid consists of

		Vauquelin.	Franherz.	Leibeg.	Prout.
Carbon	4 prop. = 24 or 38.3	29.357	41.238	40.68	
Oxygen	4 prop. = 32 —	54.9	66.863	55.879	54.24
Hydrogen	1 prop. = 1 —	6.8	4.780	2.385	4.86
Equivalent	57	100.0	100.000	100.000	100.00

Malic acid is not employed as a remedy in its free state; but, in combination, it forms the refrigerant principles of many acidulous beverages, for instance, apple tea, diluted currant juice, raspberry vinegar, and others, employed in febrile affections.

** INORGANIC PRODUCTS OPERATING AS REFRIGERANTS.

NITRATE OF POTASSA. L. E. D.—This salt is the spontaneous production of Nature in many parts of the world. It is found abundantly crystallized on the surface of the soil in India, South America, Africa, some parts of Spain, and in

* Boullay. Journ. de Pharm. 1828. p. 63.

Egypt. It is also found in great abundance in the Pulo de Mollèta—a deep cavity formed by the falling in of several caverns in the province of Puglia in Naples: it is procured by the lixiviation of the common soil near the city of Klemsan in the kingdom of Algiers; and in a cave near Mensoora, in Ceylon, there is a very rich impregnation of nitre. In the north of Europe, in Germany, it is obtained from artificial composts, which consist of vegetable and animal substances mixed with calcareous earth, formed into beds, sometimes into walls, over which roofs are raised to protect them from the weather. In France, nitre beds are also formed from the lime and plaster of old buildings, which have been inhabited by man and other animals. These plasters are reduced to powder, after having been for years exposed to the air, and mixed up with offal, decayed leaves, and other animal and vegetable matters; this powder is then lixiviated, that is, thrown into water, and after some time, being frequently stirred up, the fluid separated from the solid matters is evaporated. Sulphate of potassa is in the mean time added to decompose the calcareous salts, which are thus deposited in an insoluble state, leaving the nitre in solution. By repeated separations and evaporations, the nitrate of potassa is thus procured in its crystalline form.

The theory of the formation of Nitre, in these artificial beds, was first clearly pointed out by Mr. Cavendish. It is this:—'The animal and vegetable matters mixed up with the calcareous earth consist of nitrogen, hydrogen, oxygen, and carbon. These principles are evolved by the decomposition of the animal and vegetable matter, and, reuniting by the operation of new affinities, produce new compounds, among which we find nitric acid, which is formed by the union of the azote from the decomposition of the animal matter with the oxygen from that of the vegetable. This accounts for the acid; but how the alkali is formed, or what part the calcareous matter plays in its formation, is still unknown. Dr. John Davy is of opinion that the formation of nitre, in the soils of India, is the consequence of the natural union of *felspar* and carbonate of lime. He conceives that the alkaline base is produced by the decomposition of the felspar, and that the carbonate of lime, by some

unknown means, forms the acid by uniting its two bases, oxygen and nitrogen, in the atmosphere. This opinion, however, is purely hypothetical. Heat, to a certain degree, and moisture are essential ingredients in the formation of nitre.

The greater part of the nitrate of potassa used in this country, is procured from impure nitre, the production of the soil imported from Bengal. When brought to this country, it is dissolved in water, and boiled until a pellicle form on the surface of the liquid, after which it is poured into leaden coolers, in which it crystallizes.

Nitrate of potassa was known to the ancients, and is mentioned by Pliny; but the *Nitrum* of the ancients was a salt of soda. Roger Bacon, however, in the 13th century particularly notices it under the name of Nitre. Many chemists, as Sthal, Lemery, Thouvenel, Vauquelin, and others, have occupied themselves with the composition of this salt.

Nitrate of potassa, when pure, is in six-sided prisms, terminated by dihedral prisms. It is white, semipellucid, and brittle, inodorous, and has a bitterish, sharp taste, occasioning a sensation of cold both in the mouth and the stomach. The crystals of nitre are not altered by exposure to the air: they dissolve in seven times their weight of water, at 60° Faht. and less than their own weight of boiling water. They are insoluble in strong alcohol. When submitted to a heat above that of boiling water, nitrate of potassa melts, and, on cooling, concretes into a compact mass; which, run into moulds, is called Sal Prunelle. In a high temperature it is decomposed, and gives out about one third of its weight of pure oxygen. When nitrate of potassa is mixed with charcoal, and thrown into a red-hot crucible, it deflagrates; and carbonate of potassa is the result. Nitrate of potassa consists of 1 prop. of Nitric Acid + 54, 1 = prop. of Potassa = 48; making the equivalent 102: or, of Nitric Acid 52, + Potassa 48, in 100 parts. The salt is seldom perfectly pure, and contains, occasionally, muriate and sulphate of soda: the former is detected by nitrate of silver, the latter by nitrate of baryta.

Nitrate of potassa operates either as a refrigerant or as an excitant, according as it is taken in small or in large doses. In moderate doses of a scruple or more, it produces a

powerful sympathetic effect on the nervous system, diminishing the action of the pulse in strength and frequency, and lowering the animal heat: the skin becomes pale, and the person experiences a feeling of languor. Even in considerable doses, as ascertained by Dr. Alexander, in experiments upon himself*, it produces a refrigerant effect; but this is soon followed by reaction. In doses of from six drachms to an ounce, it causes symptoms of gastritis with vertigo, tremors, and cold sweats, which have terminated in death. Post-mortem examinations have displayed evidences of acute inflammation of the villous coat of the stomach. To obtain the refrigerant effect of nitrate of potassa, therefore, in febrile affections, the salt must be administered in moderate doses, namely, from a scruple to half a drachm, repeated at short intervals. The dose of the salt should not be dissolved until the instant in which it is to be given, and then it should be swallowed immediately after the solution is complete: when, however, the coldness thus produced in the stomach causes uneasiness or spasm, the use of the salt should be discontinued.

BIBORATE OF SODA. Syn. *Subborate of Soda*. L. E. D. —This salt is a compound of boracic acid and soda, largely prepared by the hand of Nature. In Thibet it is deposited in a lake, from which it is collected and brought to Europe, under the name of *Tincal*. When it is purified and crystallized, it is soluble in twenty parts of water at 60°, and in two parts of boiling water.

Biborate of soda is also prepared by the direct combination of its constituents, which is effected by saturating the boracic acid procured from the waters of Sasso in Italy with carbonate of soda. The acid procured from evaporating these waters contains 55 per cent. of boracic acid: this is added to a solution of carbonate of soda in a boiling state, decomposes it and unites with the soda, expelling the carbonic acid in a gaseous state; and, when the solution is saturated, the biborate is formed. The Dutch are the great purifiers of *Tincal* or crude borax; and such is the force of prejudice, that, on the

* Experimental Essays, p. 113.

Continent, the artificial salt is obliged to be sent to Holland, and re-exported as Dutch borax.

Borax, or Biborate of Soda is semitransparent; crystalized in flattened, hexædral prisms terminated by tetradral pyramids. It is slightly efflorescent, is inodorus, and has a styptic, cool, and alkalescent taste. Exposed to heat, it loses its water of crystallization, swells up like alum, and becomes a dry, white, spongy mass without suffering decomposition: in a strong heat it is vitrified. According to Bergman, the crystallized salt consists of

Boracic Acid	. . .	34 or 2 prop.	(24 × 2) = 48
Soda	. . .	17 — 1	————— = 32
Water	. . .	49 — 8 prop.	(9 × 8) = 72
		100	Equivalent 152

100 parts of the dry salt contain of Boracic acid 70,+ Soda 30 parts. It is decomposed by all the mineral acids, and the boracic acid set free in the form of small crystalline scales: these acids, therefore, and also chloride of barium, chloride of calcium, protonitrate of mercury, and nitrate of silver, which decompose it, are incompatible with it in medicinal formulæ.

This biborate exerts a peculiar action on bitartrate of potassa, and on honey, which I may take this opportunity of noticing. If six parts of bitartrate of potassa, two parts of biborate of Soda, and six parts of water, be boiled together for five minutes, allowed to cool, and filtered to separate some tartrate of lime which is always contained in bitartrate of potassa, and the solution be then evaporated to dryness, we obtain a deliquescent salt. This salt has been termed Soluble Cream of Tartar by the French chemists. A chemical union is also effected, when biborate of soda is mixed with a solution of honey and water, or when equal parts of borax and honey are mixed together, and a deliquescent salt is formed with properties altogether new. It is on this salt, therefore, not on the borax, that the efficacy of the mixture of honey and borax, in aphthous affections, depends—a fact which explains the anomaly, that borax applied to aphthæ does not produce the same beneficial effect as the honey of borax.

Biborate of soda is seldom prescribed as a general refri-

gerant in this country ; but, on the Continent, both this salt and boracic acid, under the name of *Sal Sedativum*, is employed in inflammatory febrile affections. It is, however, better calculated for operating as a local than as a general refrigerant.

B. REFRIGERANTS ACTING ON THE SENSIBILITY OF THE BODY.

COOL AIR.—The agreeable feeling produced by cool air would lead naturally to its application in a heated state of the body ; and, in fever, might have early suggested to practitioners of the healing art the propriety of employing it as a remedial agent. But such is the perversion of human beings, that the older physicians at one time opposed this instinctive desire in fever patients, and subjected them equally to the hazard and the torture of a hot regimen. In modern practice, the admission of cool air to the apartments of the sick, in all acute diseases, especially in fever, is fully acknowledged : and nothing is found so soon to change the character of the disease, and to produce a favourable crisis. It is, however, of great importance to distinguish between exposure to cool air and to cold, especially in convalescence from fever.

COLD WATER—ICE.—If cool air be serviceable in fever, cold water and ice are equally so, and their application is more extensive. Let us examine the principles upon which these agents operate, and the mode of employing them.

When cold water is applied to the surface, the effect is an immediate abstraction of heat from the part, and the extension of this effect, by sympathy, to the rest of the system : thence this powerful agent is not to be regarded as a local, but as a general remedy ; and in cases of augmented temperature, with some exceptions, which shall be particularly noticed, it may be employed in every case attended with a hot, dry skin, with a quick, hard, or tense pulse. Under every circumstance the temperature of the patient should be accurately ascertained by the assistance of the thermometer ; and the water should be about fifteen degrees below the temperature of the body.

There are various modes of using cold water as a topical

refrigerant:—it may be used under the form of the cold affusion, cold sponging, and ice.

The cold affusion implies dashing cold water over the body of the patient, who is stripped naked. The temperature of the water should depend on the season of the year, and many other circumstances: but, as a general rule, from 40° to 60° Faht. may be regarded as the average temperature: and it may be employed either with or without saline impregnations. In determining upon the propriety of using the cold affusion, we must be guided both by the condition of the patient and by our knowledge of the influence of the remedy. The sooner the cold affusion is resorted to after the rigors of the first stage of fever have abated, the better: but the safest guide is, to take the temperature of the body at its height: but, even when the thermometer indicates morbid temperature, the cold affusion should not be used if the patient feel much chilliness; nor should it be had recourse to if the temperature be less than that which may be considered healthful. The advantage of applying cold water, with these precautions, in every inflammatory fever, unaccompanied with visceral inflammation, is undoubted: it not only reduces heat and moderates the pulse, but abates, generally, the symptoms. If the temperature of the body is under that which has been already alluded to, the cool affusion, or sponging the body, is to be preferred to the cold affusion: the effect is neither so decisive nor so permanent as the cold affusion; but it relieves the morbid heat, reduces the pulse, and tranquilizes, generally, the irritability of the habit. The temperature of the water should not be below 71°, nor exceed 87° Faht. When a local effect is required to be produced, with the view of obtaining a general benefit—as for example, in the application of cold to the scalp, whenever a powerful determination to the head, manifested by great heat there, renders it necessary—the use of ice is to be preferred, or that of evaporating lotions. When cold is to be applied in this form, the scalp should be shaved, and cloths dipped in cold water, or ice in a bladder, laid upon it, while, at the same time, the lower extremities are to be kept warm.

During the hot stage of intermittents, when the surface is

dry and parched, and the general heat greatly augmented, cold in every form applied to the surface, and cold fluids taken into the stomach, are not only grateful to the patient, but of the utmost value, lessening the force and frequency of the pulse, cooling the burning heat of the skin, and bringing on the sweating stage. Its use, however, requires some degree of caution; but when it has been begun, it should be continued until the heat is reduced to the natural standard. After this is effected, and the sweating stage has been induced, then the application of cold is no longer proper; as it abstracts the heat too rapidly, inducing urgent sickness and debility. In remittent fevers, the application of cold and the administration of cold drinks are to be regulated by the same rules as in intermittents; but the local application of ice or cold water to the scalp is more likely to be required, and to demand more attention. In continued fevers, cold is advantageously employed in every form. In those fevers in particular which assume the typhoid type, ventilation and the free admission of cool air into the apartment of the sick are absolutely necessary. Cool air in these cases allays irritation, obviates debility, removes the oppression of the præcordia, and nearly produces all the advantages which can be anticipated from the cold affusion. The *dieta aquea* of the Italians is a relic of the cold drink of the ancients, which was pushed very far in continued fevers; and certainly no practice can be more judicious. But if the fears of the friends of the patient do not oppose the use of the cold affusion, this method of employing cold in continued fever is the most beneficial. Next to it is the cool affusion, and equal to this is cold sponging. Certain rules are necessary to be observed in the application of these refrigerants.

1. With regard to the kind of fevers in which they may be employed, we may enumerate five:—1. In synocha, or inflammatory fever, a very rare disease, when unaccompanied with topical inflammation, the cold affusion rapidly abstracts the stimulus of heat and diminishes the excitement under which the system is labouring; thus acting as a powerful sedative. The frequency of this disease among the ancients explains the great use made of cold drinks and cold bathing in continued

fever. 2. In typhus, the fever most opposite to that just noticed, the disease has been cut short by the cold affusion; and when this has not been the case, the symptoms at least have been greatly alleviated by its employment. 3. In synochus or inflammatory fever gradually assuming typhoid symptoms, the cold affusion has been frequently and advantageously employed: nothing, indeed, can be more beneficial when there are no local determinations; but when these exist, particularly when cough indicates a determination to the lungs, much caution is requisite. 4. In remittent fevers, especially those of warm climates, the efficacy of the cold affusion is undoubted. In yellow fever, its early application is frequently the salvation of the patient. 5. If hectic be symptomatic of determination to, or of disease in the thorax, the cold affusion cannot be employed; but much benefit often results from sponging with cold water mixed with vinegar, whilst the lower extremities remain warm in bed. Even when this fever is not attendant on any obvious local affection, or, as the term is, is idiopathic, the cold affusion can scarcely be regarded as admissible.

2. With regard to the period of fever in which the application of cold is useful, some distinct rules are also necessary. In that state of continued fever, when there is no obvious apyrexia, the cold affusion is especially indicated; and the more early it is employed, when this state shows itself, the better. Dr. Curry found that when used early, within the first three days of the fever, the complete formation of the disease was prevented; and this even occurs on the fifth day, but not later. If the fever be more advanced, the debility is generally too great to permit the system to bear the sedative influence of the cold affusion; thence the warm or tepid affusion must be substituted for it: but, nevertheless, if the symptoms indicating its use present themselves, there is no reason why it may not be employed at any period of the disease. One circumstance strongly against the employment of the affusion in the advanced stages of fever is the syncope, which generally occurs when the patient is raised into the erect position.

3. In the application of the cold affusion, we must carefully ascertain, as I have already stated, the exact temperature of

the body. In this country, in the severest attacks of fever, it has rarely exceeded 108° ; but in warm climates it rises to 112° : the higher the temperature, the more benefit is to be expected from the cold affusion. The degree of temperature must be determined by placing a thermometer, with a small bulb and curved at the end, either in the axilla, or under the tongue of the patient with the mouth shut. The sensation of heat is, also, to be attended to in fever before using the cold affusion; for the patient often feels cold whilst the thermometer indicates an augmented temperature: and the opposite state sometimes occurs; the thermometer indicates no increase of temperature, nevertheless the patient feels hot. In both cases the employment of the cold affusion is contraindicated. It is, also, contraindicated if the skin be bedewed with perspiration; and, even when other circumstances are favourable, if the patient have a great dread of it, it must not be used; for terror has been frequently observed not only to counteract the beneficial effects of it, but even to make it an injurious agent. It is, also, improper during menstruation, and in the latter months of pregnancy.

It is unnecessary to enter into the nature of the various diseases, besides idiopathic fevers, in which the refrigerant powers of cool air and cold water have been found productive of benefit. In all, much depends on the degree of the attendant fever. It must be left to the sagacity of the practitioner to determine whether any local affections exist which forbid the free application of either. In no disease does the powerful sedative influence it possesses display itself so conspicuously as in phrenitis. The most furious delirium is quickly subdued by allowing cold water to drop on the vertex, whilst the rest of the scalp is covered with cloths moistened with vinegar and water. In hæmorrhages of every kind, cold, in all its forms, is the sheet anchor of the practitioner. It is scarcely requisite to notice the havoc made by the employment of the hot regimen in small pox, and the striking advantage obtained from the free exposure of the patient to cool air: indeed, one of the greatest benefits obtained from inoculation, was the introduction of the custom of exposing the patients to cool air. At the

same time, it is candid to admit, that little judgment was displayed by those who introduced the cool regimen: it was used in the latter stages, even of confluent smallpox, and much mischief frequently resulted. During the eruptive fever, the body should be freely exposed; as it not only is benefited at the moment, but the disease is rendered milder in its future stages. Even the dread of the eruption should be no reason against the use of the cold affusion, should the body require it. The Hindoo physicians plunge their patients, in this stage of the disease, into cold water, and with the best results. It diminishes the fever; lessens the number of the pustules; and, when smallpox formerly prevailed, it was supposed to lessen the risk of pitting. In confluent small pox, in which the secondary fever is of the typhoid type, cool air and the cold affusion may be used with the same intent and in the same manner as in typhus. In scarlatina, the disease is, as it were, instantly extinguished when the cold affusion is judiciously employed during the height of the eruption.

Such are a few of the most important diseases in which cold in every form is decidedly useful; but much, it must be admitted, depends on the discrimination, the judgment, and the observation of the practitioner, in determining the temperature of the application, the time, and the exact condition of the body in which it should be employed. It is unnecessary to add to these remarks, except to point out the means of counteracting the degree of collapse which sometimes follows the application of cold water, guttatim, to the vertex. In this case, the state of sinking is to be treated exactly in the same manner as when extreme debility suddenly occurs, whatever may be the cause: external warmth, particularly the application of bladders of hot water to the scrobiculus cordis, friction, electricity, and the artificial inflation of the lungs, if the degree of collapse be very considerable, are the means to be employed; and, when the individual is capable of swallowing, the administration of excitants, particularly aromatics and ammonia.

SECTION V.

NARCOTICS.—MEDICAMENTA NARCOTICA*.

Syn.—Anodyna†, Hypnotica‡.

I have already, in part, explained my reasons for separating this class of medicines from that of sedatives: I have now to state that other distinctions exist between these two classes. In the first place, *Narcotics*, strictly so called, operate as diffusible excitants, and this so decidedly, that, by properly regulating the doses and the repetition of them, the sleep, which generally follows the administration of a narcotic, may be altogether prevented, and the exciting influence of the medicine only be obtained; whilst, on the contrary, the effect of a direct sedative is an immediate depression of the powers of the system without any apparent previous excitement. In the second place, the symptoms of depression or collapse which follow those of excitement, after the administration of a narcotic, are the consequence of the previous state: excitement is followed by a diminution of the vital powers; and, although this does not occur in the direct ratio of the degree of the excitement, yet, if it be considerable and quickly raised to its acmé, the state of collapse which succeeds is proportionate. Now, this is not the case with sedatives, which depress; not as if this were the result of a previous excitement, but of a peculiar action upon the nervous energy which at once depresses it, and, if the dose be sufficiently large, which apparently destroys both *mobility* and *sensibility*. In a few words, a *Sedative* immediately depresses the vital energies; a *Narcotic* augments these energies; and this is followed by depression. Such are the distinctions between the obvious action of Narcotics and Sedatives; and such diversities of action are sufficient to authorize the separation of these orders of medicinal agents. The confounding of these two distinct classes of medicines under one head has created

* From *ναρκοτινός*, derived from *νάρκη*, stupor.

† From the privative *α*, and *δδύνη*, pain.

‡ From *ύπνος*, sleep.—Hypnotic, a medicine which causes sleep.

many of the difficulties that have presented themselves to writers on the *Materia Medica*, in attempts to explain the rationale of their operation. Even so late and so perspicuous a writer as Dr. John Murray remarks that, in some *Narcotics*, the stimulant operation is scarcely perceptible, whilst, in others, it is evident in a very striking degree. Now, the truth is, that this diversity of action is not characteristic of different Narcotics; but all Narcotics, when administered in large doses, scarcely display their stimulant influence, and all, when administered in small doses, display it.

Regarding Narcotics in the point of view which I have described, they may be defined "medicines which, in moderate doses, produce a temporary excitement, succeeded by depression of the system, generally followed by sleep." In this definition, the soporific effect of this order of medicines is stated as one of their characteristics; but nothing is said respecting the anodyne power which they frequently also exert; because, although it is undeniable that many Narcotics are capable of alleviating pain, yet, as this is not a property of all Narcotics, it cannot correctly enter into a definition of the class.

It has been justly said that, in studying this class of medicines, we must never lose sight of the power which the brain and the spinal marrow exercise upon all the organs of the body through the medium of the nerves. Let us examine in what manner their influence is exerted upon these organs.

1. *Action of Narcotics upon the Stomach.*—The first influence of the full dose of a Narcotic taken into the stomach is exerted upon the nerves of the organ, and thence communicated to the nervous centres. What primary effect it is which this action produces on the organ itself it is impossible to conjecture; but the secondary effect, that which follows the impression on the encephalon and spinal marrow, is one which lowers the digestive powers of the stomach and places the organ, as it were, in a state of inaction. When the narcotic substance is taken into an empty stomach, the first obvious effect is to diminish the desire for food: if it be taken during the time of eating, the result is such a degree of enervation of the organ, that the process of chymification is suspended; if

a short time after a meal, the process of digestion is arrested ; and if after some hours, vomiting follows, and the food is ejected in the state in which it was at the moment of swallowing the Narcotic. These effects, however, are not confined to the action of the opium on the stomach ; for they follow its introduction into the rectum, and even its application to the skin. The effect, therefore, of Narcotics upon the stomach is to weaken its powers ; and the larger intestines, from the same cause, lose their ordinary contractility and become constipated. Some Narcotics, however—Henbane, for instance—are supposed to increase the peristaltic action of the bowels ; but these are exceptions to the general rule.

These effects of Narcotics upon the alimentary canal are modified by disease. When the mucous membrane is suffering from subacute inflammation, or is in a highly irritable state, Narcotics produce thirst and dryness of the tongue ; and vomiting is not unfrequently induced. In a state of diminished vitality of the organ, they augment the atony, increase the indigestion, and produce obstinate constipation. In cancer of the stomach, if no ulceration be present, Narcotics allay pain and diminish the uneasy sensations of the patient ; but, when there is either an open ulcer or those spongy vegetations which occur in this disease, instead of allaying, they cause an increase of pain, exciting vomiting and rigors, whilst, at the same time, the brain becomes powerfully affected. It may be asked—is this owing to the absorption of the Narcotic ?

In irritable states of the coats of the stomach, Narcotics, especially opium, when combined with tonics, instead of producing the effect already described, aids the influence of the tonics in promoting the appetite and favouring the digestive function. In peritoneal inflammation, on the contrary, instead of producing an anodyne effect, they cause anxiety, general uneasiness, and vomiting. In ulcerations and open cancer of the mucous membrane, however, they allay pain and procure momentary comfort to the sufferers. In an irritable state also of the intestinal canal, especially when spasm is present, Narcotics produce an anodyne and a salutary effect, allaying gripings and arresting the morbid movements of the canal.

2.—*upon the Circulating and Respiratory Organs.*—Nothing is more likely to lead to diversity of opinion than the effect of Narcotics on the action of the heart and arteries. A short time after taking any Narcotic into the stomach, the pulse is found in some instances small and feeble; in others full and soft; but always more or less irregular. These effects do not admit of a satisfactory explanation; but they have been referred to variations in the influence of Narcotics on the nervous energy. The power of this class of medicines over the circulation, however, is particularly manifested in the capillary system by the passive diaphoresis, the itching of the skin, and the dilatation of all the erectile tissues, which follow the use of opium or any Narcotic. The temperature of the body is also lowered—an effect evidently depending on the diminished action of the capillaries and the slow manner in which the blood is moved through them. With regard to the respiratory organs, the administration of a Narcotic is always succeeded by the number of inspirations and expirations in a given time being much fewer than natural, and consequently by an imperfect decarbonization taking place in the pulmonary circulation: thence the blood sent to the head is not adequate for the due excitement of the brain, and the whole system necessarily languishes. In cases of poisoning by opium, the blood found in the left ventricle of the heart is of a black colour.

In hypertrophy of the left ventricle of the heart, the administration of Narcotics produces a great tendency to congestion of the brain, manifested by a sensation of weight of the head, a bloated aspect of the countenance, and temporary deafness. In irritations of the mucous membrane of the pulmonary tubes, they diminish the tension and dryness of that membrane, re-establish the exhalation from its surface, and restore the healthy action of the mucous follicles. With respect to the influence of Narcotics on the respiratory muscles, as every muscular fibre is more or less dependent for its state of vigour upon the energy of the brain and spinal cord, the state of these nervous centres must influence the action of the respiratory muscles; and consequently, according to the effect produced on them, Narcotics may be regarded as influencing these muscles.

3.—*upon the Secerning System.*—Little that is satisfactory is known upon this subject. If Narcotics be administered in doses sufficient to maintain their stimulant operation, without exhaustion, there can be no doubt that the secretions will be augmented, in as much as the stimulus is communicated to the glandular capillaries, and an increased supply of blood afforded to them. As an objection to this opinion, it may be said that the alvine evacuations generally become pale from a deficient supply of bile after opium has been taken; but, in this case, the defect depends rather upon the paralyzing influence of the opium upon the excretory ducts than upon the secreting power of the liver; and this reasoning may be extended to the rest of the glandular system. That the function of the salivary glands is affected by Narcotics, is supposed to be evinced by the dryness of the mouth which follows the administration of a full dose of opium; but this also may depend on the state of the excretory ducts. One fact seems to confirm the opinion that Narcotics do not diminish glandular action; namely, that opium has never succeeded in lessening the flow of saliva produced by mercurials: on the contrary, it is asserted by Theussing that it has sometimes produced salivation*. On the urinary organs some Narcotics, especially opium, produce a decided effect; and thence its employment in the treatment of diabetes. But it may be questioned whether the diminished secretion of urine be not owing to the increased flow of perspiration which the opium induces, rather than to any influence which it exerts on the kidneys?

The aphrodisiac influence of Narcotics does not prove that these substances particularly augment the spermatic secretion. It has been asserted that opium diminishes the secreting powers of the mammæ: Geoffrey maintained that it augments them†: but observations are wanting to establish the accuracy of either opinion.

Upon the whole, we may safely conclude that the facts which have been brought forward in proof of the influence

* Charvet, de l'Action comparée de l'Opium, p. 217.

† Mat. Med. vol. ii.

of Narcotics on the discerning system are not sufficient to enable any decided opinion respecting it to be hazarded.

4.—*upon the Nervous System.*—Narcotics exert their chief influence on the nervous system; for, although they are undoubtedly received in the circulation, and produce almost immediate death when they are injected into the veins, yet, even in this case, their influence is propagated chiefly by nervous communication—a fact demonstrated by the experiments of Messrs. Morgan and Addison*, who discovered that they produce on the inner coats of the blood vessels a peculiar impression, which is conveyed to the brain along the nerves. This is, also, demonstrated by their rapid effects on every part of the system, often in a space of time too short for these effects to be referred to absorption; besides, it is well known that, when the dose has been so large as to be quickly followed by fatal effects, the whole quantity of the narcotic administered has been found in the stomach. From the nature of the nervous system, there is no difficulty in comprehending the manner by which this communication of impression is effected. But this action of narcotics is not confined to their primary application to the nerves of the stomach; for if any narcotic—opium, or belladonna, for example—be applied to the surface of the body, the same results follow, only in a diminished degree: if the application be to an entire membranous surface, the energy of the narcotic influence is in the ratio of the absorbing power of the membrane; and if it be injected into the thorax, between the lungs and the ribs, the action is still more rapid than when the narcotic is taken into the stomach. The fact, however, of the introduction of narcotics into the circulation cannot be denied; but, when a narcotic is applied to a wound, its operation does not essentially depend on its absorption into the blood, although its influence, in a great degree, can be impeded by a ligature on the blood vessels; and when it is injected into the veins, the animal instantly expires, and this without convulsions. In this experiment, all the muscles of the body, both voluntary and involuntary, are instantly deprived of their contractile power, and, therefore, both the

* Essay on the Operation of Poisonous Agents on the Living Body, p. 73—89.

action of the heart and that of the respiratory muscles ceasing, death must necessarily be the immediate consequence. From these remarks, we may conclude that narcotics act on the *brain* and on the spinal *marrow* by entering the circulation, when taken in moderate doses ; but, when swallowed in doses sufficient to prove rapidly fatal, that the effect is the result of their immediate influence on the nervous energy ; and, farther, that when they are taken into the circulation, we must still refer their effects to the direct impression which they make on the nervous system.

The nerves more particularly affected by narcotics and sedatives are the respiratory. This was particularly evident in a series of experiments conducted by Mr. Brodie. He introduced, in one instance, a drop of the volatile oil of bitter almonds into a wound in a rabbit ; after five minutes, respiration had ceased ; but the heart was still felt beating through the ribs ; and, by renewing and keeping up respiration by artificial means for sixteen minutes, spontaneous breathing was re-established, all the functions of the brain revived, and life was in fact restored. It is not easy to explain why one set of nerves should be more particularly influenced than another by narcotics. A most respectable writer on the action of opium asserts, that opium exerts a powerful sedative influence exercised directly on the contractile tissues, independent of the nervous centre. He, also, contends that the primary excitement is exerted directly on the brain and spinal marrow, the cerebro-rachidien centre, as he terms it, while the sedative effect is the result of the action of the narcotic on the contractile fibre. This opinion might be thought to be, also, confirmed by the experiment which has been frequently made, that of applying opium to the inner surface of the frog's heart, and observing that the immediate cessation of its contractions is the consequence. There is some difficulty in disproving this opinion, in the present state of physiological science ; but, if the fact of the sedative influence being the effect of the previous excitement be admitted, there is no necessity for referring the phenomena to a separate action on two distinct tissues. I must not, however, be misunderstood : I do not mean to affirm that the sedative effect of

a narcotic, by which I mean to imply the state of collapse that succeeds, in general, the excitement which it induces, is an invariable consequence of that primary action ; for, were this the case, we should find that all substances which rapidly exalt the powers of life would produce narcotic effects, which is not the case. Thus, we well know that when nitrous oxide is breathed, it produces a sudden and high state of excitement ; yet, it is not followed by that proportional depression which succeeds to a dose of opium, or of alcohol, large enough to produce an equal degree of excitement. There is still, therefore, something connected with the operation of narcotics which we cannot explain, and which must remain a mystery until we acquire more correct ideas of the nature of nervous energy than our present limited knowledge admits.

5. *Circumstances which modify the action of Narcotics.*—

* *Quantity.* The effect of a moderate dose of any narcotic on man is in the first instance stimulant. The activity of the heart and arteries is augmented, and a slight sense of fulness is felt in the head. Some febrile symptoms, also, present themselves with an unusual degree of exhilaration ; which, however, soon subsides, and drowsiness steals on, until it terminate in perfect sleep. If the dose be sufficient to prove poisonous, giddiness and stupor are felt without any previous apparent excitement ; as this increases, the individual becomes motionless and insensible to external impressions ; he breathes slowly, and the whole expression of the countenance denotes deep and sound repose. By degrees, however, the features change and acquire a ghastly character ; the pulse sinks, and becomes at length imperceptible ; the muscles relax, and death *rapidly* closes the scene.

The period in which these symptoms display themselves varies greatly, according to the kind of narcotic employed, and, also, according to the state of the patient. If opium be the narcotic, sometimes the systems will show themselves in a few minutes ; but, in some instances, an hour has been known to elapse after a large dose has been swallowed. If, as in a case recorded in the 49th volume of the London Medical and Physical Journal, the person be habituated to stimulants,

many hours may elapse before any stupor exhibit itself. In this case, we are authorized to infer the diminished susceptibility of the nervous system; for collapse had already occurred. The individual who took the preparation of the opium was drunk, and the dose of laudanum was fʒii. All that we can assert, therefore, is, that narcotics exert their influence through the medium of the nerves; that their primary action is stimulant; and that this is followed by a state of collapse or depression, provided the result of the dose administered be allowed to take place without interruption. From what has been said, however, it is evident that the stimulant effect of narcotics may be maintained as long as the system can support a state of excitement; but, as this effect is transitory, the dose requires to be repeated at very short intervals; and it must also, as far as regards quantity, be of a nature not to operate in such a degree as to bring on rapidly the state of collapse, which necessarily, under every circumstance, must follow the high excitement of the living system. Narcotics, therefore, according to the mode of administering them, and according to the extent of the dose administered, will act either as stimulants or as sedatives; and, therefore, in many morbid states of the habit, they may be employed to produce either of these effects. In general, however, they are exhibited with the view of obtaining that state of diminished susceptibility of impression which is required in various diseased states of the habit; to allay inordinate action; to obtund the sensibility of the body to the impression of irritating causes; to sooth pain, and to induce sleep. How do narcotics induce sleep? is a question which is very frequently put, but scarcely ever satisfactorily answered. Some approach to truth, in framing a reply, may be attained by keeping in view the state of the vital functions during sleep: the pulse is slower, respiration is also slower than when the individual is awake; the temperature of the body is diminished; the perspiration is decreased, and nearly all the secretions are suppressed. Now, on whatsoever principle narcotics act, if they lessen the force and frequency of the circulation, and at the same time diminish the respiratory effort, the change of the venous blood into arterial must be necessarily impeded; and this, alone, by

weakening the energy of the brain, will produce sleep. I offer this hypothesis, however, rather as a suggestion than with any hope that it will be adopted.

Narcotics induce sleep ; but, nevertheless, they cannot be employed for this purpose in cases in which their previous excitement would prove injurious, unless the dose be large enough to induce symptoms of diminished sensibility and action, without any previous increased action ; and experience has informed us that this is the result when the dose of a narcotic is sufficiently large. In a practical point of view, the recollection of this fact is of primary importance ; since the state of a patient may be either greatly improved, or materially injured, according to the extent of the dose of the narcotic which it may be thought proper to administer. Thus, if we suppose a case of pleurisy, in which the pulse is hard, quick, and forcible, and the pain of the side so acute as almost to prevent a half-inspiration, so that the breathing is short and difficult ; if, after a free and copious abstraction of blood, two or more grains of opium, in conjunction with calomel and tartar emetic, be administered, I shall have every reason to anticipate the most beneficial results : but, if half a grain only were ordered, not only would no advantage accrue from the remedy, but, the stimulant effect only of it being obtained, the benefit of the bleeding is likely to be counteracted, and the repetition of the dose would only tend to increase the evil. In this respect the action of narcotics does not differ from that of direct stimulants. A large dose of alcohol, or any ardent spirit, produces depression without any previous perceptible increased action ; whilst in small doses it stimulates the system, augmenting the vigour of the muscular action, and exalting the nervous energy. In all cases, therefore, of increased excitement, when pain or restlessness demands the administration of a narcotic, the dose should be sufficiently large to obtain, at once, its anodyne effect, without the primary stage of excitement.

The stimulant effect of narcotics, in small doses, is frequently taken advantage of in the treatment of fevers of a low or typhoid type. The tincture of opium, for example, given in doses of ten minims, at short intervals, increases the strength

of the pulse, frequently rouses the vigour of the system, and supports strength more effectually than either wine or any other stimulant.

* * *Habit.*—Like some other stimulants, narcotics lose their influence when their use is continued for some length of time; and doses have been ultimately taken which would at first have proved fatal. I knew a lady who gradually had arrived at the power of taking, three times a day, a wine-glassful of the officinal tincture of opium, which contains about one grain of opium in nineteen minims; making the dose equal to fifty grains of opium. Of this effect of habit on opium no satisfactory explanation has yet been given, although M. Charvet has attempted one. Assuming that the state of congestion of the vessels of the brain is admitted as the effect of an overdose of opium, he supposes that the frequent use of opium renders this congestion less powerful; or that the brain, accustomed by degrees to the flow of the blood and the resulting compression, at length is enabled to bear it with impunity, in the same manner as when a serous effusion *gradually* occurs, or a tumor is *slowly* developed within the cranium. It must, however, be noticed that this modification of influence on the living system is not common to all narcotics; and, indeed, it is a curious fact, that there is less similarity of action in the different articles of this class of medicines than in those of any other of the *Materia Medica*. There is no class of medicinal bodies, as Dr. Paris has justly remarked, which are less disposed to bend and conform to an artificial arrangement: each would seem to have its own particular mode of operation, and to affect sensibility in its own peculiar manner: thence the practitioner will often find that, after the failure of one narcotic, the administration of another will induce sleep. I must, therefore, defer giving any general view of the various diseases in which narcotics are indicated, and confine my observations on their influence, in particular diseases, to the history of each individual narcotic.

* * * *Climate.*—In noticing the effects of climate in modifying the operation of Narcotics, I may mention that Dr. Harrison has recorded two instances in which the ordinary dose, gr. iv, of the extract of henbane produced a temporary amau-

rosis, which disappeared, and again recurred, on the alternate suspension and administration of the medicine, when taken in Italy; although the same dose, of the same parcel of the medicine, taken in England, had produced no effect of the kind. This is the case with many other narcotics: some attention is therefore required in prescribing narcotics, to accommodate the dose to the nature of the climate in which the physician is practising. Regard must also be paid to the season of the year: thus, the dose of a narcotic administered in summer requires to be smaller than one for the relief of the same symptoms, *cæteris paribus*, administered in winter. Hecquet explains this influence of temperature by saying, that as heat favours the flow of sweat, the opium is carried off by it, and is thus prevented from materially affecting the brain: but Chavret, with more probability, supposes that, as copious sweating diminishes the mass of the circulating fluids, and renders the cerebral compression less powerful, the sweating may be regarded as a favourable crisis, which guarantees the brain from over compression. Both opinions are hypothetical: and it is more likely to depend on the greater irritability of the habit in summer than in the winter, and the consequent greater susceptibility of impression.

*** *Idiosyncrasy*, also, is more apt to influence the effect of narcotics than other classes of medicines. I know many individuals on whom opium operates in the most singular manner: in one lady it never produces its soporific effect until the day following that on which she takes it: and an instance of the same peculiarity in a man is mentioned by Lorry, who also details the case of a woman who was thrown into furious delirium, spasms, and convulsions, even by the external application of opium: in some persons, I have seen it produce restlessness, delirium, and convulsions; in others, a miliary eruption of the skin. Other narcotics produce similar effects on some habits. We may also refer to *idiosyncrasy* the effect of narcotics on the Malay race. When a Malay wishes to revenge some real or supposed injury, he intoxicates himself with opium, and, armed with his cress or dagger, he runs forward, striking all who happen to be in his way, until he be either disarmed or destroyed. In the same

people, also, convulsions are frequent results of large doses of opium—an effect which very rarely occurs in Europeans. This may depend on an increased degree of nervous susceptibility, and a higher exaltation of the nervous energy. It is the same condition of the nervous system that renders infants bad subjects for the administration of narcotics: in them narcotics produce rather irritating than calming effects: thence palpitations of the heart and convulsions not unfrequently follow the administration of opium to infants.

Were this the place to take a retrospective view of the history of the introduction of this class of remedial agents, we might trace the general employment of Narcotics from a very early period. The nepenthé of Homer was evidently some narcotic. Galen informs us that he overcame an attack of watchfulness by eating a lettuce in the evening. There are few nations, either civilized or rude, who have not had recourse to the aid of Narcotics, either for the purposes of medicine, or for alleviating the cares and sorrows of life. Were moral rectitude the guide of human conduct, and the happiness of mankind founded upon the consciousness of performing aright all the duties of his station, in the exercise of his social affections and those of his faculties either of body or mind, narcotics and stimulants would soon lose the value which is attached to them as aids to the pleasures of sense, and cease to be hailed as the resources of the wretched—“cura et molestia liberans, et omnium malorum oblivionem inducens.” But as this is not the case, we observe the best gifts of Providence, those designed for the removal of pain and the prop of feebleness, abused, and erroneously regarded as the balm of sorrow and the promoter of pleasure. “The Western Asiatic,” says Christen, in his excellent work on Opium, “obtains it from his Agaric; the Southern from Opium and Bang; whilst the more polished Europeans in wine and spirituous liquors ‘ducunt sollicitæ jucunda oblivia vitæ.’”

6. *Poisonous effects of Narcotics.*—Before commencing the consideration of the particular Narcotics, I deem it necessary to make a few remarks on their general action as poisons. Many diseases present symptoms that closely resemble those

produced by Narcotics when operating as poisons. Dr. Christison has given the best and most succinct view of these ; and, in offering the result of my own observations, I shall borrow freely from the facts which his industry and research have accumulated.

When an overdose of a Narcotic has been taken, the ordinary symptoms are headache, vertigo, dulness of vision, stupor, or perfect insensibility ; occasionally convulsions of a tetanic kind and coma precede the fatal termination. Post-mortem examinations of the bodies of those who have died from taking Narcotics have displayed the brain gorged with blood, and frequently water in the ventricles.

Some of the symptoms attending apoplexy closely resemble those of the narcotic poisons. They may be distinguished, however, by several circumstances : thus, if there have been warning symptoms, such as giddiness, vertigo, palsy, and noise in the ears ; if the patient be above fifty, and the attack begins abruptly during a meal, or very soon after it ; if, when after the sopor has begun, the patient cannot be roused to any consciousness, and the pupil is greatly dilated, with a bloated appearance of the face—we may conclude that the case is apoplexy. There is also another symptom, which is very conclusive—the absence of any odour of the narcotic in the breath ; for although, after death, no trace of opium can be discovered in the stomach, yet, during life, the odour of the narcotic is generally more or less perceptible in the breath.

It is only in cases of what is termed simple apoplexy that the post-mortem appearances closely resemble those displayed in the brain in poisoning by Narcotics. In congestive apoplexy, the minute injected state of the brain, with extravasation, forms a ready diagnosis ; and in serous apoplexy the distinction is equally obvious.

Between some cases of poisoning by Narcotics and *Epilepsy* the diagnosis is more difficult : for instance, the effects of belladonna, conium, stramonium, and some of the poisonous Fungi, closely resemble the symptoms of epilepsy : but the epileptic fit is more abrupt in its attack ; the state of sopor is different, and the patient cannot be roused from it. The sleep, also, which closes an epileptic fit terminates suddenly ;

the patient awakes, rises, and seems as if nothing had occurred: but the sopor of narcotics passes off slowly, and leaves the habit weak, tremulous, and exhausted. When death occurs in epilepsy, it never takes place in the first attack—a circumstance in itself sufficient to distinguish death from epilepsy from fatal cases of poisoning by Narcotics.

The distinction between Narcotic poisoning and *Meningitis*, as well as inflammation of the substance of the brain, are sufficiently obvious, although some writers have stated the possibility of their being confounded with one another; nor is there any difficulty in forming the diagnosis in *Hypertrophy* of the brain, which is always a chronic and slow disease; and even in the event of a sudden termination, the appearances which the brain presents are sufficient to guide the medical jurist in his decision. Instead of simple turgescence of vessels, as in Narcotic poisoning, there is unusual emptiness of the blood vessels both of the brain and its membranes, which are also, in general, uncommonly dry.

Narcotics may be arranged under two distinct heads. Those which exert a direct influence on the nervous system, without necessarily entering the circulation, I would designate *Direct Narcotics*: those which enter the circulation before acting on the nervous system I would designate *Indirect Narcotics*. It is not my intention to maintain that the theory of the operation of direct Narcotics is exclusively that of sympathetic action; although I must contend that, even when they enter the circulation, their influence is still exerted on the nervous energy. Indeed, if we even admit the accuracy of every experiment that has been made by the Continental physiologists, and the inference that the Narcotic must be transmitted to the brain through the blood before it acts, these opinions do not stand in the way of the greater probability that, in large doses, direct Narcotics act by an immediate impression on the sentient extremities of the nerves. The views opened by Messrs. Morgan and Addison, demonstrating that, even in entering the blood vessels, *Narcotics*, and more especially opium, produce on their inner coat an impression which is conveyed along the nerves, is a powerful evidence in favour of the doctrines which I maintain.

TABLE OF NARCOTICS.

A. DIRECT NARCOTICS.

* *Organic Products.*

a. MORPHIA—

combined with Meconic Acid, in
Opium ;

Extract of Poppies :

————— *with Sulphuric Acid*, in
Sulphate of Morphia :

————— *with Muriatic Acid*, in
Muriate of Morphia :

————— *with Acetic Acid*, in
Acetate of Morphia :

Battley's Sedative Solution ?

Black Drop ?

————— *with Citric Acid*, in
Citrate of Morphia.

b. ATROPIA—in the leaves of

Atropa Belladonna. 5. 1. Solaneceæ.

c. ACONITIA—in the leaves of

Aconitum Storckii. 13. 3. Ranunculaceæ.

d. CONIA—in the leaves of

Conium maculatum. 5. 2. Umbelliferæ.

e. DATURIA—in the herbaceous part of

Datura Stramonium. 5. 8. Solaneæ.

————— *Ferox.* — — —

f. DIGITALIA—in the leaves of

Digitalis purpurea. 14. 2. Scrophularinæ

g. HYOSCIAMIA—in the leaves of

Hyosciamus niger. 5. 1. Solaneæ.

h. LUPULIA—in the strobules of

Humulus Lupulus. 22. 5. Urticeæ.

i. CAMPHOR—obtained from

Laurus Camphora. 9. 1. Laurineæ.

Dryobalanops Camph. 13. 1. Dipterocarpeæ.

k. UNKNOWN PRINCIPLE—contained in

Rhododendron cry-

santhum. 10. 1. Erinaceæ.

Lactuca <i>sativa</i> .	19. 1. Compositæ.
———— <i>virosa</i> .	— — —————
Arnica <i>montana</i> .	19. 2. —————
Rhus <i>Toxicodendron</i> .	5. 2. Anacardiaceæ.
* * <i>Inorganic Products.</i>	

l. ETHER—

* *free*—

Ether sulphuricus.

* * *combined*—

Spiritus Etheris Sulphurici.

Spiritus Etheris Aromatici.

———— Etheris Sulphurici compositus.

B. INDIRECT NARCOTICS.

m. TINCTURES OF NARCOTICS.

n. VERATRIA—contained in

Colchicum *autumnale*. 6. 3. Colchicaceæ.

C. MENTAL NARCOTICS.

Music ;

Gentle friction.

ORGANIC VEGETABLE PRODUCTS WHICH OPERATE AS
NARCOTICS.

a. MORPHIA. Syn. *Morphina*. *Morphine*.—This is a saline body which exists in opium, in combination with a peculiar acid, which has been named the *meconic*, in the form of a meconate.

Morphia, when pure, is in white, small, flat, hexangular, prismatic crystals. It is inodorous and has a bitter taste ; is scarcely soluble in cold water or even in boiling water ; is also insoluble in ether ; but very soluble in boiling alcohol, from which it precipitates on cooling. Its alcoholic solution restores the blue colour to litmus feebly reddened with an acid ; and forms crystallizable salts with the acids ; thus proving its alkaline nature. When nitric acid is poured on Morphia, both the acid and the salt are decomposed, and an orange-red solution is produced. When Morphia is suspended in water,

and treated with a drop or two drops of permuriate of iron, it acquires a dirty indigo-blue colour, which is instantly destroyed by any acid, by alcohol, and acetic ether. When it is added to a solution of pure iodate of potassa, and a drop of sulphuric acid agitated in the solution, iodine is evolved, colouring the solution orange brown, and giving an indigo-blue colour to mucilage of starch.

Morphia, when exposed to heat, melts if the temperature be not too high, and, on cooling, assumes a crystalline, radiated appearance; but, in a strong heat, the melted mass is charred, white fumes are disengaged, and, if the air be freely admitted, the mass burns like any other vegetable body. Strong sulphuric acid also chars Morphia.

According to the experiments of Dumas and Pelletier, Morphia consists of

	Bussy.	Pelletier and Dumas.	Brandes.	Henry and Plisson.
Carbon	69.0	72.02	72.00	70.52
Hydrogen	6.5	7.61	5.50	7.98
Nitrogen	4.5	5.53	5.50	4.78
Oxygen	20.	14.84	17.00	16.72
	<u>100.0</u>	<u>100.00</u>	<u>100.00</u>	<u>100.00</u>

In opium, as I have said, Morphia is combined with meconic acid: it is owing to the decomposition of this meconate, and the insolubility of Morphia, that precipitates occur when the alkalies, particularly ammonia, acetate of lead, salts of baryta, &c. are added to solutions of opium.

Morphia was discovered by a German chemist of the name of Sertürner, an apothecary at Eimbeck in Hanover, in 1804*; but it was not until 1817, at which time Sertürner published his method of procuring it, and named it *Morphia*, that the nature of this salt was understood. It has since been examined by various other chemists, particularly by Robiquet; and its properties have been fully described. Sertürner ascertained that it exists in opium, in combination with a peculiar acid, which he named *meconic*.

Were we to trace the history of opium, we should be disposed to believe that Morphia had been obtained from that

* Ann. de Physik, vol. xxv, p. 26.

substance long before Sertürner's time. Ludwig, in his work *Dissertationes de Pharmacia*, the second edition of which was published in 1688, mentions a salt which he calls *magisterium opii*, procured from opium by dissolving it in an acid and precipitating by an alkali: Wedel, in his *Opiologia*, speaks of the salt of opium, which Hoffman also observed, and describes its crystals as prismatic and acicular, resembling those of the flowers of benzoin: Neumann, Beaumé, and Eccard, also mention the salt of opium.

The French assert that morphia was discovered by Seguin; but, although it is true that this excellent chemist read a paper on this salt to the French Institute in 1804, the same year in which it was discovered by Sertürner, yet his paper was not published until 1814; whereas, Sertürner's was published in 1805. The discovery was made, in fact, by both chemists without communication with one another; but, as Sertürner went farther than Seguin, the merit of the discovery of Morphia is fairly due to him.

Morphia combines with the sulphuric, muriatic, acetic, and citric acids, and forms salts. If the mineral acids be employed to neutralize it, they must be previously diluted with water, as the concentrated acids decompose morphia.

*Meconic acid**, the only base with which morphia has yet been found naturally united, is obtained free in a crystallized state, generally of a reddish colour; but, when it is sublimed with care, at a temperature of 248° , it is procured in white octohædral prisms. It has a slightly acid taste, slowly changing to nauseous bitter: it is inodorous, is soluble in water and in alcohol, reddens the solution of litmus, and, when united with solutions of permuriate or persulphate of iron, acquires a deep cherry-red colour, without affording any precipitate, and a saturated blue with salts of gold: it is precipitated emerald-green by the salts of copper, and white by those of lead and baryta. The discovery of this acid affords a solution of the effects of these reagents on the tincture of opium, which had been observed before meconic acid was known. This acid possesses no medicinal powers. Like morphia, it

* Named from *Μηκων*, the poppy.

was observed to exist in opium before it was actually obtained in a separate state ; which was effected by Sertürner, and its properties ascertained in 1804.

Morphia, in combination with the meconic acid, the meconate of morphia, is prepared by the hand of Nature in the living system of the white poppy, the *Papaver Somniferum*, forming the *meconate of morphia*, the narcotic principle of opium.

1. *Opium* is the inspissated proper juice of the *Papaver Somniferum*, a plant belonging to the natural order Papaveraceæ*, a native of Persia ; but, it is also found growing naturally in all the warmer parts of Asia, in Japan, the Island of Mauritius, in Egypt, and in Greece : and it is now naturalized to nearly the whole of Europe. There are two varieties of the plant ; one, named the black poppy, with purple-coloured petals, open capsule, and blackish-grey seeds ; the other with white petals, a short capsule, and white seeds. The latter is that which is most generally cultivated in this country†.

All the parts of the poppy, except the seeds, contain a white or milky-looking proper juice, possessing narcotic powers : the seeds contain a bland fixed oil and a farinaceous albumen, highly nutritive. It is from the capsule of the poppy that Opium is extracted. The method of procuring it is the same as that described by Dioscorides and Pliny ; and the periods chosen for collecting it are the same, as far as regards the growth of the plant.

The Opium is extracted from the half-ripe capsule seven days after the petals fall, when the capsule begins to harden. The incisions are made with an instrument called *nahrea*, which has five cutting points ; and are repeated every second day for a fortnight. They are made both longitudinally and *transversely*, on one side of the capsule, at night, or at least after sun-set. If we reflect that the sap-vessels, in which the proper juice of the poppy is contained, run vertically,

* Woodville's Med. Bot. third. ed. p. 376, pl. 138.

† Professor Murray, in his celebrated work, the *Apparatus Medicaminum*, has fallen into the extraordinary mistake of stating that the height of the poppy, in Persia, is forty feet !

the advantage of the transverse incisions will be obvious. These vessels lie immediately under the cuticle of the capsule, and therefore it is of importance not to make the incisions so deep as to penetrate into the cavity of the capsule. The juice exudes during the night, and is scraped off with a small iron scoop on the following morning before the sun shines on the plant; and, in the evening, the capsule is again wounded, on the opposite side, for another gathering of the juice. The effluvium is so great, says M. Freygau, who witnessed the operation in Georgia, that the gatherers, who are generally women and children, are sallow, meagre, and often palsied. There are three collections in Persia: the first is called *gobaar*; it is strong and of a pale yellow colour; the two others are weaker than the first and almost black. When the collection is completed, the whole is wrought up together with wooden spathulas, in wooden vessels, to the consistence of pitch: it is then formed with the hand into cakes, or sometimes cylinders, and covered over with leaves. Such is the mode of procuring Opium in Persia, whence the greatest supply of the drug for European consumption is obtained, under the name of *Turkey Opium*. According to Olivier, the best Opium of Persia is that which is gathered in the southern provinces. The same method is followed in Bahar, and in Bengal, where the East Indian Opium is collected; and some specimens have been lately sent to Europe which, in appearance, equal the best Turkey Opium; but no satisfactory analysis has yet been made to ascertain the quantity of morphia which this improved Bengal Opium contains*.

There are four *kinds* or rather *varieties* of Opium known in commerce: Turkey Opium, East Indian Opium, Egyptian Opium, and European Opium.

Turkey Opium is in thick round cakes or masses, generally flat on one side and convex on the other, and covered with the leaves of the poppy and the capsules of some species

* Opium is probably also a production of the animal kingdom: an hemipterous insect, the *Coccinella bipunctata*, ejects from its joints a yellow fluid which has a strong smell of opium.

of *Rumex*, which are considered an indication of its goodness, as the best Opium only is thus covered. The best Turkey Opium is solid, tenacious, of a clear, fresh, reddish-brown colour, breaking, when dry, with a shining fracture, having a heavy, strong, narcotic odour, and a bitter, hot taste; its specific gravity is 1.336; it is very inflammable, and burns with a clear flame. When dry, it is easily pulverized, yielding a yellowish-brown powder, which is again aggregated if wrought in the hand. Dr. Christen and others state that it is nearly wholly soluble in water; but I have never met with any which did not leave some insoluble portion, generally one part in twelve; and this has a plastic character somewhat resembling the gluten of wheat, is of a deep-brown colour, and perfectly tasteless. Turkey Opium is bad, and should be rejected, when it is of a deep-brown colour, almost black, of a soft, plastic, unctuous or grumous consistence, or if it be friable and rough. It is also bad if the odour be empyreumatic, the taste sweetish and neither very bitter nor acrid, if it tinge the saliva brown or black when charred, if it afford a deep-yellow solution with water, and can scarcely be filtered.

Turkey Opium is frequently adulterated. When the adulteration is the extract of the capsule or that of the whole plant, prepared by boiling in water, the colour of the Opium is blacker than usual, and the Opium is harder; the taste is weaker than genuine Turkey Opium; it is also empyreumatic; it is not inflammable, is totally soluble in water, and affords a turbid alcoholic solution. When the adulterating substance is the extract of the horned poppy, *Chelidonium Majus*, this is detected by the odour and by the brown-yellow colour of the solution. Adulterated with the extract of liquorice, the specimen is brittle and tastes sweet; and, when with gum Arabic or Tragacanth, besides being fragile and shewing a smooth, shining fracture, it forms, when rubbed with one part of alcohol and two of water, a tremulous, gelatinous mixture. Opium, when mixed with any fatty matter, gives a turbid tincture: when mixed with sand and gravel, which is very common, in order to increase the weight, the Opium feels gritty between the teeth,

and these insoluble matters are left when it is dissolved in water*.

East Indian Opium has hitherto been very inferior to Turkey Opium. Its smell is generally more empyreumatic, its taste less bitter, and it is less acrid, than the Turkey Opium: it is also smoother, blacker, more friable; and, when triturated with water, the whole is taken up, eight parts in twelve being perfectly *dissolved*, and four *suspended* in the fluid. The specimens of Bengal Opium lately sent home are of a very superior quality: they are in square cakes, weighing about four ounces each, and packed in neat wooden boxes with plates of mica between each piece†.

Egyptian Opium closely resembles, in every respect, the Turkey Opium. That brought from Thebes, in Upper Egypt, was formerly in great esteem: thence the name *Thebaicum* is still used to imply select Opium. Of late years, the Pacha has encouraged the growth of Opium in Egypt.

European Opium is chiefly the production of France and of England. In France, it has been prepared more in the form of an extract from the stem, capsules, and leaves of the unripe poppy than after the fashion of exotic Opium; and the object of those who have cultivated it has been rather to procure an extract containing a large proportion of morphia than real Opium§. Thus, the *opium indigène* of M. Ricart Duprat of Toulouse‡, of M. Loiseleur-Deslongchamps, and of M. Barbier, is merely a good extract of poppies. M. Peyre, however, the Apothecary General of the Military Hospital of Toulon, has prepared some Opium after the Oriental manner, in Provence, which is said to equal the best Bengal Opium; and M. Lainé has also prepared Opium in the same manner at Malley, near Lausanne||. In England, the efforts to make good Opium have been very successful,

* Stones and leaden balls are occasionally found in the masses or lumps of Turkey Opium.

† Opium is cultivated in India chiefly for the China market. The produce is so great, that the sales in 1808 produced £594,978. Although very superior to what it was some years since, yet the East India Opium is still very inferior to that of Persia.

§ Mem. sur les Succédan. de l'Opium, t. ii, p. 81. ‡ Journ. de Pharm. 1823.

|| Journ. de Pharm. vol. viii.

the experiments having been conducted exactly on the plan adopted in Persia. The most successful of the English cultivators has been Mr. John Young*. His Opium has been analyzed, and has been found to equal the average Opium of commerce in every respect: it contains even more meconate of morphia; and is therefore a powerful soporific; but it has little perceptible odour of Opium, owing, it is said, to the volatile oil being dissipated by the heat employed in its preparation. I fear, however, that the uncertain state of the weather, in our variable climate, and the high price of labour, will render our efforts to rival the Persian in his Opium as abortive as our attempts to equal the wine of the Rhine and the Garonne.

Mr. Morewood states that the quantity of Opium imported into England, in fifteen years prior to 1801, was 286,271 pounds, of which 247,619, or 16,508 pounds annually, were consumed in the country†; and it is probable that both the supply and the consumption are now considerably greater. Besides Opium, an excellent extract, *Extractum Papaveris*, containing one grain of morphia in seven grains, is made from the capsule of the indigenous poppy for the purposes of medicine.

Opium, thus prepared, whether the production of Asia or of Europe, owes its soporific and narcotic properties solely to the meconate of morphia. It contains three other principles, narcotina, discovered by M. Derosne, in 1802‡, and regarded as the soporific principle, until I proved the error of this opinion by a comparative analysis of East India and Turkey Opium; Narceine, and Meconine. I ascertained, by analysis, that a much larger proportion of Derosne's salt exists in East Indian than in Turkey Opium, although much larger doses of the former are required to produce the usual effects of the drug than of the Turkey Opium—a fact which completely set aside its claims to the title of the soporific principle. Narcotina has been supposed, by M. Majendie, to be the stimulant principle of opium; but this opinion is too hypothetical to be hastily adopted. In the crystallized form, it is in white, inodorous, insipid, rhomboidal

* Trans. of the Society of Arts, vol. xxxvii.

† Essay on Inebriating Liquors, p. 106. ‡ Journ. de Pharm. 1827.

prisms, scarcely soluble in water, but very soluble in alcohol, in ether, and in volatile oil. It does not display the alkaline properties of morphia; nitric acid forms with it a yellow solution. It is easily distinguished from morphia by putting some of it on blotting paper and submitting it to a moderate heat: it melts and is imbibed by the paper as if it were resin. According to the analysis of Pelletier and Dumas, its constituents are carbon 68.88, + nitrogen 7.21, + hydrogen 5.91, + oxygen 18, = 100. From the experiment of Orfila, it appears that the solution of narcotina in oil proves fatal to dogs in small doses; but its effects on man are yet undetermined: it is not employed as a medicine*. Narceine is a late discovery of M. Pelletier. It is obtained in needle-shaped crystals. Meconine is also a new principle. Having finished our examination of the chemical properties of morphia, meconic acid, and narcotina, those of narceine and meconine shall be afterwards noticed; and having, also, pointed out the sources of Opium, and the characters of the varieties of it found in the market, let us now enquire into its chemical constitution, as determined by analysis. It would be a sacrifice of time to describe the early analyses of Opium. Neumann analyzed it in 1730, Zeucher in 1745, Rumpel in 1773, Josse in 1776, Lorry in 1777, and Bucquet and Beaumé nearly about the same time. The more recent analysis of Harrison was published in 1784, that of Crumpe in 1793, and of Eccard in 1800. The first analysis of any interest is that of Bucholz, in 1800†: it was followed by that of Derosne in 1803, when narcotina was discovered; and those of Sertürner and Seguin in the following year, when the important salt, the meconate of morphia, was first brought to the light. The best analyses are that of Robiquet, the model of analytical accuracy to every young analyst, and the recent one of Pelletier. From the combined labours of these distinguished chemists, an ac-

* Orfila and Dr. Bally assert that, when narcotina is dissolved in very dilute hydrochloric acid, it may be given with impunity in doses of sixty grains: but half that quantity dissolved in weak acetic acid produces the same effects as in cases of poisoning by the salts of Morphia. One curious circumstance follows the administration of the acetate to dogs: in doses of gr. xxiv it produces convulsions, with a strong impulse to move backwards

† Tromsdorff's Journ. vol. viii.

curate idea of the composition of Opium has been obtained. Its constituents are—

1. *A volatile oil*, on which the odour peculiar to good and well-prepared Opium depends;
2. *Gum*, including *bassorine*;
3. *Extractive*, partly simple, partly more than usually oxygenated;
4. *Resin*, with which the colouring matter is closely combined;
5. *Caoutchouc*; or rather a substance resembling birdlime;
6. *Narceine* or *Narceina*;
7. *Meconine*;
8. *Morphia*, in combination with *meconic acid*;
9. *Narcotina*;
10. *Sulphates of lime and of potassa*;
11. *A brown acid*;
12. *Lignine* or woody fibre.

In taking a view of each of these components, I shall confine my remarks to those which exert some activity on the animal system; admitting at the same time that all of them may more or less influence the virtues of the medicine.

The *volatile oil*, although affording a powerful odour to Opium, yet is in such small quantity that it can scarcely be procured in a separate form. Water in which Opium is distilled has a turbid milky aspect; and on this account it was at one time thought to be narcotic; but this distilled water has been given to animals in large quantities without producing the smallest narcotic effect. When administered to man, it is productive of that slight cephalalgia which many other odours excite.

The *Resin*, before the discovery of the meconate of morphia, was regarded as a very important part of Opium; and to its presence the stimulant quality of the medicine was referred. It exists in very small proportion, not more than nine per cent.

The *Narceine*, the new principle, lately discovered by Pelletier, is obtained from the fluid which remains after the morphia and narcotina have been separated, by adding to it

muriate of baryta; so as to neutralize all the meconic acid. The excess of baryta is to be separated by carbonate of ammonia; after which the fluid is to be concentrated, and left at rest in a cool place, until a deposit is formed, which is to be pressed through linen; and, after being treated with alcohol, and passed through pure charcoal, left to crystallize. These crystals are narceine: they are white, quadrilateral prisms, soluble in alcohol and water, insoluble in ether; and have a bitter, styptic taste. They melt at 199° Faht. and when combined with concentrated acids strike a beautiful blue colour and form neutral salts. The action of narceine on the animal œconomy is unknown. The *meconine* is also a new principle discovered by Pelletier. It is obtained from the ether used to procure the narcotina: it is soluble in hot water, and crystallizes on cooling.

The *meconic acid*, as I have already stated, was first separated by Serturmer, in 1804. Schroeer, towards the close of the seventeenth century, had noticed that a watery solution of opium effervesced with carbonate of potassa and ammonia; and Tournefort, from its effects on vegetable colours, suspected that it contained a free acid; but this was supposed to be the acetic, or the malic. Meconic acid is separated from the morphia, with which it is combined in the opium, by precipitating an aqueous solution of opium, or a salt of baryta, by means of ammonia, or acetate of lead. When ammonia is used, the meconate thus formed is retained in solution: when a salt of baryta or of lead is employed, the meconates precipitate. These meconates may be decomposed by the sulphuric acid, and the meconic acid procured in a separate state. Other methods have been also employed: thus Robiquet prefers using magnesia instead of ammonia for precipitating the meconic acid. This meconate of magnesia is dissolved in diluted sulphuric acid: by the addition of muriate of baryta, a sulphate and *meconate* of baryta are precipitated, and muriate of magnesia remains in the solution. By digesting the precipitate in hot very dilute sulphuric acid, and filtering, crystals of meconic acid are procured as the filtered fluid cools. One disadvantage arises from the use of magnesia; it never can be totally freed from the acid.

This acid is supposed to be procured in its purest state by sublimation*: it melts at 289° of Fahr. and then sublimes; but the sublimed salt does not possess the same chemical properties as the common acid, and is probably a pyro-acid. In a greater heat, it chars and is destroyed. It is owing to this acid that so many precipitations take place in the aqueous and alcoholic solutions of Opium on the addition of the solutions of the metallic salts; meconates of their bases being readily formed and precipitated. The exact quantity of meconic acid in Opium has not been ascertained, as it exists both in the free and in the combined state. Its only apparent use in the Opium is to confer solubility on the morphia.

Morphia, the most important of the constituents of Opium, is separated by many methods. I will notice a few only of the most approved. The following is a modification of Sertürner's, proposed by M. Hottot: eight ounces of Opium are to be macerated in repeated portions of cold distilled water, and the filtered fluids evaporated till they acquire a specific gravity of 1.012: when half cooled, gr. $24\frac{1}{2}$ of carbonate of ammonia are to be added to the inspissated solution, and the precipitate allowed to fall; the fluid is then to be decanted and gr. 141 of carbonate of ammonia added to it. The whole is now to remain at rest for twelve hours, then filtered, and the residue evaporated with cold water and treated with f ss of alcohol and gr. 141 of animal charcoal, filtering after the alcohol has boiled. As the spirituous solution cools, the morphia crystallizes.

Instead of using ammonia, Robiquet boils the aqueous solution of Opium with calcined magnesia. The magnesia decomposes the meconate of morphia, forms a meconate of magnesia, and throws down the morphia in conjunction with the meconate of magnesia; by washing these alternately with very dilute cold and hot spirit, the colouring matter is taken up in a great degree; after which, by boiling the residue in strong alcohol and filtering, the morphia crystallizes as the spirit cools; the meconate of magnesia remains inso-

* M. Choulant, however, has stated that when meconate of baryta is mixed with equal weights of vitreous boracic acid and exposed to heat, it readily separates from the baryta, and sublimes in fine white shining scales.

luble. Another method, proposed by Stratinghs, is to boil $\text{f}\text{z}\text{viii}$ of powdered Opium with zvi of sulphuric acid, diluted with $\text{f}\text{z}\text{xvi}$ of water, for half an hour, and then to strain through a linen cloth; the residue is next to be boiled with $\text{f}\text{z}\text{cxxxviii}$ of water acidulated with fzvi of sulphuric acid, and the filtered solution precipitated with potassa. The residue, dried on the filter without heat, is next to be boiled in fzvi of strong alcohol. Crystals of morphia fall as the alcoholic solution cools. For practical purposes, perhaps, the simplest of all methods is either to rub up zviii of Opium with $\text{f}\text{z}\text{xxx}$ of water acidulated with distilled vinegar, and, after filtering and evaporating the fluid to fzx , to precipitate by ammonia, added as long as any precipitate falls: or to employ the following method suggested by me. Digest zviii of Opium, in powder, with $\text{f}\text{z}\text{xxx}$ of distilled water for twenty-four hours, then triturate the whole well together, strain the solution, and, having evaporated to $\text{f}\text{z}\text{xii}$, precipitate with muriate of baryta. Separate the meconate by filtration, and precipitate the morphia from the dissolved muriate by ammonia. In both cases the precipitates are morphia—coloured, it is true, but sufficiently pure for practical purposes.

The chief objections to the processes for procuring morphia in beautiful crystals is the waste of alcohol: to obviate this, Messrs. Henry and Plisson have suggested the following method of separating it with a very small quantity of spirit. They rub up Opium with twice its weight of water, acidulated with hydrochloric acid, and repeat this operation three times. The filtered fluid is reduced by evaporation to $\frac{2}{3}$, and solution of ammonia added in slight excess. After separating the precipitate, some more hydrochloric acid is added to the mother water, which is then evaporated and decomposed as before. The residue is now to be neutralized with hydrochloric acid, boiled with animal charcoal, and evaporated to form crystals; the mother water, again evaporated to yield more crystals, and so on until all are obtained. The crystals thus procured, after three crystallizations, are to be dissolved in a water acidulated as before, and decomposed by a slight excess of ammonia. The morphia separates under the form of a light yellow pow-

der, free from narcotina, and furnishes, when boiled in alcohol and animal charcoal, extremely beautiful crystals.

A simpler method is that which I employ : the muriate of morphia is formed, as already described, by means of the muriate of baryta ; and then precipitated from its solution by means of magnesia ; boiling the precipitate with alcohol, and proceeding as ordered by Robiquet.

The proportion of morphia procured from a given weight of Opium varies according to the process employed to extract it : but the average quantity is about fifteen per cent. The Opium grown in France has yielded to M. Petit from sixteen to eighteen per cent ; and, in one specimen of French Opium, M. Caventou obtained twenty-eight per cent. I have made no experiments on English Opium with this view ; but, as its narcotic powers are superior to those of Turkey Opium, we may conclude that the per centage is equal to that of the French Opium.

The *Narcotina* is most readily procured by digesting the residue in ether, after the separation of the muriate of morphia, evaporated to the consistence of an extract. The ethereal solution is to be distilled to save the ether, and the residue treated with weak alcohol, which only takes up the narcotina. Such are the means of procuring the active principles of Opium ; but it must be acknowledged that chemistry has not yet extracted from Opium any principle which produces exactly the same effects as the opium itself. I am of opinion that the aqueous extract, if not the most powerful preparation of Opium, is nevertheless the most certain, and contains all its active principles : it is probable that this proceeds from the very soluble nature of the meconate ; and that the best preparation of the morphia would be the meconic, or rather bimeconate, for the meconic acid is in excess in Opium. I am at present engaged in a course of experiments to determine this point ; and to discover an æconomical method of preparing this salt. In the aqueous extract the whole of the active principles of the Opium are not taken up ; for the residue, when acted upon by alcohol, yields morphia. According to the experiments of Mr. Phillips, cold water takes up thirty parts in seventy-two, boiling water ten parts

more, and rectified spirits, with the aid of heat, seven parts more: thence the best of the officinal extracts is that of the Dublin College, as boiling water is employed in its preparation. If the narcotina be really the stimulant principle of Opium, the proposal of Robiquet to separate it by agitating the extract with ether, as soon as it acquires the consistence of syrup, by which the narcotina is taken up, would greatly improve this preparation. In prescribing the aqueous extract in solution, it must be recollected that it yields insoluble precipitates with the salts of baryta, magnesia, nitrate of silver, bichloride of mercury, sulphate of copper, and acetate of lead. These precipitates are meconates, and the morphia, with the acid base of the metallic salt, remains in solution: thence the indication for which the metallic salt is prescribed cannot be fulfilled.

Morphia, separated from Opium, is combined with various acids for medicinal purposes.

2. *Sulphate of Morphia*.—For preparing the sulphate, the morphia is to be dissolved in alcohol, aided by heat, and the diluted sulphuric acid gradually added until the alkali is neutralized, which can easily be determined by means of litmus paper. If wholly evaporated in this state, the solution acquires some degree of colour; and, therefore, after evaporating one half, it should be boiled with animal charcoal, and filtered while hot. On cooling, the salt is deposited in crystals. The solution of the sulphate of morphia is decomposed by potassa, soda, and ammonia, and the morphia precipitated in a nearly insoluble state: it is also precipitated by the salts of baryta, of lead, and all substances which have a powerful affinity for sulphuric acid. It is a useful narcotic: the dose is half a grain.

3. *Muriate of Morphia* may be prepared by the direct combination of its constituents, and obtained in the form of prismatic crystals, devoid of colour: but, when prepared from Opium, it generally retains a yellow tint. My method of preparing it from Opium is, to decompose the aqueous solution of Opium by muriate of baryta: the baryta unites with the meconic acid, and forms a meconate, which is precipitated, whilst the freed muriatic acid combines with the morphia, and forms a soluble muriate, readily procured in crystals by eva-

poration. The crystals form in beautiful tussocks. It has a bitter taste, but is nearly tasteless when largely diluted: it is decomposed like the sulphate, by the alkalis and their carbonates, by magnesia, lime, nitrate of silver, acetate of lead, phosphate of soda, and infusions of astringent vegetables, which, therefore, cannot be prescribed in conjunction with this salt; but it is not affected by the muriate of baryta, nor by carbonate of magnesia or bichloride of mercury, which, therefore, enables us to prescribe it along with these salts. It is the best of the salts of Morphia, affecting the head little, and scarcely displaying any exciting powers. Its dose is half a grain.

4. *Acetate of Morphia*.—This salt is best prepared by adding to four parts of morphia, dissolved in eight parts of distilled water, acetic acid of the sp. gr. 1.075, until litmus paper is scarcely tinged red. The solution is then to be evaporated to dryness, and the salt reduced to a powder, and kept in well-stopped phials. The manner of effecting this evaporation is apt to vary the strength of the preparation: and if it be allowed to deliquesce, it also becomes weaker. If the evaporation be conducted in vacuo, it may be obtained in crystals. It has been more used than any of the other salts of morphia, as a substitute for opium: it is probably the active ingredient in the Black Drop, and also that of the preparation known by the name of Battley's Sedative Solution. It possesses one advantage over all the other salts of morphia, that it may be administered in combination with the salts of lead.

5. *Citrate of Morphia* is formed by the direct combination of its components. It has only been used in solution, in a preparation which has not come into general notice.

All the salts of morphia are decomposed and precipitated by that combination of tannin with gallic acid which is contained in astringent vegetable infusions and decoctions; consequently none of them admit of combination in prescriptions with these preparations.

The manner in which Opium acts upon the animal œconomy involves an enquiry of great importance and deep interest, in a practical point of view: in proceeding with it, let us first enquire into the operation of Opium in the form in which Nature has supplied it, the simple, inspissated, proper juice

of the *Papaver Somniferum*, *Opium*; and afterwards into the peculiar effects of one of the active principles which chemistry extracted from it, *Morphia*, and its compounds.

The writings of Hippocrates inform us that the most striking effect of the operation of Opium on the animal œconomy, its soporific power, was known to the Greeks; as, in mentioning the juice of the poppy, Hippocrates uses the phrase *υπνοτικου μηκωνιον*, the sleepy juice of the poppy. But, although the Father of Physic was aware of the power of the poppy to produce sleep, yet the introduction of Opium as an article of the *Materia Medica* is due to Serapion, the chief of the sect of the empirics who flourished in the year of the world 3700, or 248 years before the Christian era. Notwithstanding this early knowledge of Opium, it remained for the present era both to discover its active principles, and to explain the manner in which they act upon the living system.

Like all other narcotics, the primary effects of Opium are those of an excitant. The experiments of Charvet have demonstrated that its effects are not confined to the human system, but felt by that of all animals, whether mammalia, birds, reptiles, amphibiæ, fishes, or zoophytes*: it also affects the vegetable œconomy. In the human race, its effects are produced whether it be introduced into the stomach, or injected into the rectum, or into a vein, or applied to parts endowed with great sensibility, or to wounds and ulcers, or the surface of the body even when the cuticle is entire. The exciting effect first produced is followed by sopor and coma; and, if the dose be large, death ensues. In the mammalia, with the exception of man, no cerebral congestion is induced; the general nervous centre is affected as by an irritant, and death takes place amidst convulsions.

When taken into the stomach of a healthy man, Opium undergoes a partial digestion; the inert parts of its components pass into the composition of the chyme, in the same manner as the ordinary food: but, during this process, some degree of fulness is felt at the epigastrium, and the sensation of hunger, if it existed, disappears. In the mean time, the active principles of the Opium, being probably in a great degree

* De l'Action comparée de l'Opium.

separated from its other components, begin to display their influence on the nervous system by a slight sensation of heat in the face, and of distension in the temples: these feelings are followed by hilarity of mind, and a vivacity of imagination similar in many respects to that resulting from wine or alcohol. Opium, however, produces effects both *similar* and *different* from those of wine and alcohol. Like wine, it rouses the animal appetites and inspires courage; so that the Turks and other oriental people employ it both as an aphrodisiac and before going into battle. During the existence of the exciting influence of Opium, whilst mental energy and the powers of the corporeal system are considerably augmented, although the cuticular secretion is increased, yet most of the other secretions are diminished: the urine is scanty and high-coloured; and the pale, clay-coloured aspect of the alvine discharges would indicate a greatly diminished excretion of the bile: but, from the turgid state of the biliary ducts in animals poisoned by Opium, there is reason for supposing that this secretion is augmented. Such are the primary effects of Opium: if the dose be not repeated, the person gradually becomes dull and languid, and sleep ensues. This sleep, however, although sometimes, like "the golden slumbers of repose," it is accompanied with the most delightful dreams, yet is also as frequently disturbed and restless, and the mind is filled with horrors and the most terrific visions.

If the dose be large enough to prove fatal, the effects, instead of being such as I have described, are giddiness and those of a sudden depression of all the powers of life; the sleep, that quickly follows, appears at first deep and perfect; the breathing is slow and soft; the eyes are shut and the pupils contracted; by degrees, however, it assumes the semblance of that caused by sanguineous compression of the brain; and is sometimes accompanied by stertorous breathing, as in apoplexy. There are also the same cold sweats, and occasionally, although rarely, convulsions: but the state of the pulse differs greatly from that which we find in apoplexy, being small and less frequent, instead of being full and quick. As the effects of the poison increase, the features become ghastly, the pulse feeble and imperceptible, the mus-

cles relaxed, and, unless it be averted, death follows. Sometimes none of these apoplectic symptoms supervene, but the fatal event steals on imperceptibly, and the person expires as if in a deep and sound sleep : on the other hand, Nature has been known to bear up against the force of the poison, and the patient to awake, after a long sleep, without any consciousness of what has passed.

If the dose of Opium be moderate, and not repeated, the effects of it upon the habit gradually subside, and the health remains unimpaired : but if it be large, and have been frequently or daily repeated, it wears out the powers of both mind and body ; the person is rendered melancholy, dull, stupid, and unfit for the business of life : emaciation of the body follows ; his countenance, to use the language of the poet—

“ like to a title page,
Foretels the nature of a tragic volume ;”

he sinks into a state of premature old age ; palsy generally seizes him ; he becomes a drivelling idiot ; and dies in a state of the most miserable fatuity.

Let us now enquire upon what principles these effects can be explained. In this enquiry, five important queries present themselves:—1. Does Opium always act at first as a stimulant ? 2. On what does its sedative effects depend ? 3. Upon what part of the animal organization does it immediately act ? 4. Is its general influence on the habit altogether sympathetic, or is it absorbed into the circulating mass ? and, lastly, how is its action modified by *age, sex, temperament, habit, climate*, and other circumstances ?

With regard to the first object of enquiry, although I have stated that the primary effect of Opium is stimulant, yet, upon this point there have existed great differences of opinion : but it is not my intention to discuss opinions ; let us look to facts. When taken into the stomach, speaking generally, Opium causes a sensation of heat, quickens the pulse, excites the system, and exhilarates the mind. If it be dissolved in water, and applied to the eye, the urethra, or any tender, irritable surface, it causes pain ; and the same thing occurs if it be applied to a denuded muscle. These effects are analogous

to those of other excitants ; and they take place both in the healthy, and also in the diseased state of the habit. Numerous instances might be adduced of the excitement which it produces previous to its soporific and depressing effects. In the Teriakihana, the opium shops of Constantinople, it is given in combination with rich syrups and confections, in divided doses of from ten to one hundred grains. The sombre Turks sit in a row, and as the person who administers the drug passes along, he throws into the open mouth of each a small lozenge containing the apportioned dose. To show the perversion of the human mind in its appreciation of the various aids to luxury, even when they lead to the abuse of the most salutary gifts of Providence, these lozenges are stamped with the words *Mash Allah*, " the work of God." This administration of the *Mash Allah* is repeated at certain intervals, until the symptoms of intoxication present themselves, when the delirious Turk is thrust out of the house, and reels along the streets in the same manner as the habitual drunkard, after his usual dose of gin or brandy. De Tott, in his Memoirs of the Turks, mentions that his language master used to get drunk and poetical with Opium or brandy indiscriminately. The stimulant effect of Opium in supporting the Turkish couriers in the long and rapid journeys which they perform, without tasting food, is another unanswerable proof of its exciting properties.

In disease, the exciting effects of Opium are equally conspicuous. In the low and sinking stages of typhus, it is often advantageously administered in small, frequently repeated doses, instead of wine.

That the primary influence of Opium, therefore, is exciting, we have sufficient reason to infer ; and thence the injury it causes in all cases of existing excitement, and whenever inflammatory action generally prevails ; as, for instance, in affections of the chest, attended with an accelerated circulation, and hard, dry cough. But in stating this fact, it is also necessary to add, that much depends upon the nature of the dose ; something on the mode of administration of the medicine ; on the state of the circulation at the time ; and even on the hour of the day at which it is given.

With regard to the dose, if it be small, that is, from a quarter of a grain to a grain, in about three-fourths of an hour after it is taken, besides the symptoms already described (p. 528), the mouth and pharynx become dry, and the pulse is sometimes accelerated ; at other times it is small, unequal, and intermitting. If the dose be from two to four grains, in addition to these symptoms, in an augmented degree, there is the sensation as if an ample meal had been taken ; the pulse is frequently full and strong ; the patient is restless and fidgety : and, with the mental excitation, there is often more or less of a tinge of melancholy, according to the natural bias of the disposition of the individual. After a short time, the sensation of oppression at the stomach increases to nausea, and sometimes produces vomiting, which is followed by a strong inclination for repose ; the exterior impressions are feebly perceived, the ideas become vague and indistinct, and sleep supervenes. During this sleep, which is far from being natural, the pulse continues slow and full, the respiration is deep, and a profuse sweat bedews the whole of the body. On the following day, all the feelings which usually follow a debauch of wine are experienced, with a costive state of the bowels, which generally continues for three or four days. If the dose be still greater—if, for instance, a scruple or thirty grains be taken, and be not quickly rejected by vomiting—the symptoms of primary excitement are scarcely perceptible ; the pulse is small, rarely accelerated, almost always slow and irregular. In a short time, however, extreme agitation, tremors, anxiety, and spasmodic twitching of the tendons come on ; these are soon followed by a flushed face ; the eyes are brilliant and prominent ; the pupils dilated and immoveable ; the look fixed and stupid ; and the throbbing of the carotids indicates a high state of cerebral action. In this state the patient may be roused from the comatose sleep which stupifies him ; but, as soon as he answers any question, he again drops asleep ; the respiration becomes laborious and stertorous ; occasionally, it appears interrupted altogether for a few moments ; cold sweats, with a feeble intermittent pulse, follow ; and the sedative effects of the medicine are now felt in every part of the system. At this period the fate of the patient is

inevitable : the whole muscular system becomes paralyzed ; liquids fall into the œsophagus as if into an inert tube ; the destroyed irritability permits distension of the intestinal canal, to a great degree ; the respiratory muscles cease to act ; and death supervenes in the midst of combined symptoms of asphyxia and apoplexy. In these results of the administration of Opium, both the stimulant and the sedative influence of the medicine are obvious when a dose is moderate ; but when it is sufficiently great to prove fatal, the sedative effects appear to supervene without any previous excitement : so much is the operation modified by the extent of the dose.

With respect to the mode of administering the medicine, if the effects of a moderate dose of opium are dissipated, the administration of a much smaller dose, after a short interval, produces more intense effects than the first dose ; although the reverse of this follows the continued use of the drug. Much, also, depends on the condition of the digestive organs. If the stomach be empty when the Opium is taken, the excitement is great, the pulse remains small and hard, and symptoms of cerebral congestion rarely appear : on the contrary, if the same dose be taken after a meal, the congestive phenomena appear soon and are very obvious. These results, however, are much influenced by the period of the day in which the Opium is administered. When a grain of Opium is taken into a fasting stomach, in the morning, the excitement is great, and sleep seldom follows ; if the same dose be taken in the evening, scarcely any excitement supervenes ; or, as soon as the first symptoms appear, the desire of sleep is so great that it is impossible to avert it. The sleep, however, is not sound, but is disturbed by dreams ; a bitterness is felt in the mouth, and costiveness is as great on the following day as if a large dose had been taken. It has been asserted that Opium exhibited per anum has a much greater influence upon the habit than when it is taken into the stomach ; and this is said to be owing to the gastric juices altering the nature of the medicine and weakening its narcotic power ; whilst in the rectum no such change occurs, and if the gut be not loaded with fæces, the Opium is rapidly carried into the habit. But this reasoning is more specious

than true: the gastric action tends merely to disengage more quickly the morphia, which is indigestible, whilst no such evolution takes place in the rectum. Thence, notwithstanding the results of some recent cases, much larger doses of Opium can be administered by the rectum than by the mouth.

Such are the facts which establish the primary stimulant influence of the internal administration of Opium. The question might naturally arise, is its sedative effect the result of this excitant?

Some experiments of Dr. Crumpe throw considerable light upon this subject. He separated the skin from the muscles in the posterior extremities of several frogs. On some he poured a strong watery solution of Opium, on others ammonia, on some alcohol, and through others he passed electrical sparks. The result of these experiments was the deprivation of the limb of sensibility and motion: this state followed the use of Opium in ten minutes, the ammonia in one minute, the alcohol in three minutes, and the electricity in an imperceptible space of time. On cutting out the heart of a frog and subjecting it to the same substances, he found its irritability destroyed by the Opium in ten minutes, by the ammonia in two, by the alcohol in three, and by the electricity in a moment. In another experiment, having brought the heart into view, and having injected the Opium, the ammonia, and the alcohol into the intestines, he found that the action of the heart was at first excited by all of them; but its velocity soon gradually diminished, and its action at length altogether ceased. From these experiments, it is evident that Opium excites the powers of the system, and that its excitement is followed by the same collapse as that of any other stimulant, destroying by it the vital power, and this in proportion to the violence of the primary excitement. But Opium produces, also, peculiar effects dependant on its sedative influence. Thus the sleep which follows the excitement of this narcotic is not that which follows the intoxication of alcohol; and no ordinary excitant possesses the anodyne power of Opium. It is, therefore, fair to conclude, that whilst Opium is a substance possessing some properties in common with other excitants, it, at the same time,

possesses some peculiarities, as far as concerns its sedative influence over the living system, which distinguishes it from all other substances.

With respect to the part of the organization on which the influence of Opium is chiefly exerted, there is much diversity of opinion. It was once supposed that the effects of this powerful medicine depend on changes in the blood; some asserting that Opium rarified, others that it condensed this fluid; and from these opposite states the same result was supposed to be produced—the compression of the nerves at their origin. The difficulty of supporting this hypothesis by any thing like demonstration, left it to drop to the ground, where it lay long until again raised by Fontana, who, from some minute experiments, drew the following conclusions: That the blood is the medium through which Opium acts, and that it operates independently of the nervous system. He drew this inference from the fact, that when it is applied to the brain or the nerves, it produces no effect; that when the heart of a frog is cut out and placed in a solution of Opium, it is not deprived of its irritability sooner than when it is placed in common clean water: but that when the Opium is injected into the veins, it instantly causes death. Some physiologists, again, have supposed that it acts solely on the muscular fibre, destroying its contractile power.

It is unnecessary to enter the critical arena to argue the merits of these opposing hypotheses. It has been satisfactorily decided that Opium acts primarily on the nervous system, and through that part of the system destroys the irritability of the muscular fibre. With regard to the part on which it more immediately acts, it has been maintained by Dr. White and Dr. Alexander, that it acts on the part to which it is directly applied. In support of this opinion, they contend—1. That the action of Opium, in large quantity, is so sudden that there is no time for absorption. 2. That when a small quantity is injected upon the heart, the irritability is destroyed and death generally ensues. That when, instead of throwing the injection into the heart, it is introduced only beneath the skin, the irritability of the heart remains for a considerable time after death—a proof that no Opium had

reached it ; that when the transmission, by the absorbents, is cut off, the effects of the Opium are still felt over the whole system ; and, lastly, that it causes a paralytic affection of the muscles of the parts. The contrary opinion was maintained by the elder Monro and others, who maintained that, after the nervous connection between the trunk of the body and the extremities is destroyed, still Opium applied to the limbs produces the same effect as when the connection is entire ; that when a large portion is exhibited, all the excretions smell of Opium ; and that the application of it to the surface relieves pain in a distant part, in the same manner as if it had been taken into the stomach.

Although my own opinion is unshaken, that Opium acts upon the habit independent of the medium of the circulation, yet I do not mean to deny that it is possible it may be also taken into the circulation under peculiar circumstances : but such an absorption is not essential to the production of its effects. The most formidable arguments in favour of absorption are the following :—1. the time which supervenes between taking a dose of Opium and the manifestation of its influence on the system—a time sufficient, certainly, for the absorption of the narcotic. To this I reply that the intimate combination of the meconate of morphia with the other constituents of the drug requires some time before it can be so far separated as to be able to act with energy on the sentient extremities of the nerves of the stomach ; for we find that the time which supervenes is in the direct ratio of the state of solution and separation from the other constituents of the Opium in which the meconate exists in the preparation employed. 2. The augmentation of the symptoms for ten or twelve hours, although the Opium is as much in contact with the nerves in the first quarter of an hour as at the end of the twelve hours. This argument is more difficult to answer than the former, and certainly indicates absorption. 3. The greater influence of morphia combined so as to form a soluble salt, than in its pure insoluble state. I reply that, if we except mechanical irritation, it is obvious that whatever operates on the nervous system is likely to prove more energetic in the ratio of its solubility ; so that this supplies no argument in

favour of absorption. 4. The rapid effects which follow the injection of the Opium in solution into the veins. I shall have occasion very soon to explain the reason why this effect should take place, even if the hypothesis of direct action on the nervous system be admitted as applicable to Opium. There are many facts, however, which tend to shake the opinion which I entertain; and one of the strongest is related by M. Barbier, who met with an instance in which an infant was affected through the milk of the mother, who had taken a large dose of the wine of Opium. Still, there are phenomena attending the administration of this narcotic that cannot be explained, in any way, by the doctrine of absorption, nor without admitting the influence of a direct impression on the nervous energy. It is by this supposition only that we can explain the fact that many of its most striking effects take place long before any appearance of cerebral congestion is evident: namely, the dilatation of the pupils, the immediate relief which its application affords to a decayed tooth when under the influence of toothache, and the immediate effect of opiate frictions in allaying local pains. It is only by admitting the influence of Opium on the sentient extremities of the nerves, that we can readily explain the relief obtained in these instances. Besides, the action of Opium on the habit must necessarily diminish the activity of the absorbents; and, if we believe that absorption is a vital operation, and not one of pure physical imbibition, we can scarcely suppose that such an effect can occur if it must depend on the action of this function. Passing from conjectural points, on which a difference of opinion must always exist, let us now enquire into those circumstances which we have already stated as influencing the action of Opium on the system.

Age has a powerful influence in modifying the action of Opium. The younger the individual, the more energetic is its action on the system: thence the caution requisite in its administration to infants. It often proves more irritating than sedative; and instances are recorded in which convulsions and even epilepsy have followed its administration to children. In general, even in the form of syrup of poppies, a preparation too frequently given to children by lazy nurses,

marasmus follows its frequent use, with a slow nervous fever depending upon the continued cerebral excitement produced by the medicine, which gradually undermines the powers of the constitution.

Sex influences the operation of Opium less than other circumstances; but still it exerts some influence; and we find that spasms, dyspnœa, and obstinate vomitings, more frequently follow its use in *women* than in *men*.

With regard to *temperament*, there is no difference of opinion that a large dose of Opium is more dangerous in those of a *sanguine* than in those of a melancholic temperament, and in a state of plethora likely to favour cerebral congestion than in a spare condition of habit—a fact which ought not to be lost sight of in practice. In those individuals also who are easily affected by wine, and in whom inebriety is quickly produced, a small dose of Opium causes powerful cerebral excitement: thence the truth of the maxim of Tralles—“*Illi vero omnes qui vinum non bene ferunt vix bene ferent opium.*”

Custom powerfully modifies the action of Opium on the animal system. Many instances are recorded of the enormous doses of it which have been taken with impunity by individuals who have long accustomed themselves to the use of this narcotic. When an habitual use is made of Opium, it is necessary to augment the dose in order to render its effects sensible; and the most enormous doses have been taken with impunity. Dr. Russell, in his History of Aleppo, states that a Turk, of the name of Mustapha Shatar, an opium-eater in Smyrna, took daily three drams of the drug; and even then found a necessity for increasing the dose. M. Dhere, a French writer, mentions the case of a French officer who took a dram of pure Opium daily. Such individuals sometimes appear in good health; but, in general, they are pale and emaciated; and, in the case of the French officer, an alvine evacuation was procured once only in eight days, sometimes once only in fifteen days. The discontinuance of this habit is extremely difficult. Chardin mentions, in proof of this, a particularly striking instance of some Turks, Persians, and Arabs, who, having been taken prison-

ers, were at sea so long that their stock of Opium became exhausted ; and, as it could not be replaced, they all became ill, and were sinking one after another into a state of disease ; until it occurred to the captain to distribute to them wine, which answered the same purpose. This habitual use of Opium produces a peculiarly depressing influence on the habit : as soon as the excitement it causes is over, a depressing dejection of spirits, almost bordering on despair, follows, and the person becomes more and more wretched, until a judicious renewal of the stimulus is had recourse to, when this appears to recall him to life. Marsden, in his History of Sumatra, relates that the Malay soldiers, who use Opium to excess, commonly appear emaciated ; but, on the other hand, the Limen and Batang Assi gold traders, who are an active, laborious class of men, indulge as freely in the use of the drug as any others whatsoever, and nevertheless are the most healthy and vigorous people in Sumatra. We thus perceive that custom has the power of so far modifying the effects of Opium that it is deprived of its congestive effect. It is, nevertheless, true that the habitual use of it is such as to wear out the powers of life and bring on, as I have already stated, a premature old age. The effects of Opium, in this case, bear a remarkable resemblance to those brought on by an excessive indulgence in venery. When this habit is continued, marasmus and decrepitude follow as consecutive results ; and the same circumstances occur when Opium has long been taken.

This effect of the abuse of Opium must not be confounded with the use of it in extraordinary doses in the treatment of disease. When pain is present, it is truly wonderful to what extent it may be administered. I have given, in cases of the passing of gall-stones and of renal calculi, upwards of eight hundred drops of the tincture of opium in less than twelve hours, without any apparent effect, except that of relieving the excruciating torture under which the patient was suffering. Dr. Chapman mentions an instance in which a wine-glassful of laudanum was taken several times in twenty-four hours, for many months in succession, to alleviate pain in the passage of biliary calculi ; and yet, after the patient was finally

recovered, no bad effects whatsoever were perceptible on any of the functions of the frame. He also states that Dr. Monges and La Roche of Philadelphia had given it, in a case of cancer of the uterus, to the extent of three pints of laudanum, besides a considerable portion of solid Opium, in twenty-four hours, without any effect except that of relieving pain. It is not easy to account for this effect of Opium on the diseased habit: but the fact is indisputable; and it instructs us how far we may proceed in administering it in cases of disease.

Combination also greatly modifies the operation of Opium on the animal system. In combination with antimonials, its diaphoretic powers are greatly increased, as well as rendered less likely to impede the other secretions. With acids, half the usual dose will produce the effect of a full dose—a result evidently depending on the production of a soluble salt. When it is intended to procure sleep by the administration of Opium, we should not combine it with *aromatics*. These increase the stimulant effect of the medicine and lessen its sedative influence. It is by combining it with confections of aromatics and syrups that the Turks are enabled to use it as wine for promoting hilarity and conversation. In Persia, in particular, it is taken in this form in society, in the same manner as we take tea and coffee; and, instead of becoming drowsy, those who partake of it become more lively, and often more quarrelsome, than if they had indulged freely in the use of wine. The Chinese have a process for freeing Opium of its odorous and virulent principles, so as to enable them to smoke it along with their tobacco.

Climate modifies considerably the effects of this narcotic. In those who pass from colder to warmer climates, smaller doses of it are requisite to produce the desired effect than were necessary in the climates from which they have passed.

It has been supposed that Opium acts with more energy on some races of men than on others. The Javanese slaves commit the most furious and desperate acts under its influence, not only immolating the objects of their hatred, but also every one who comes in their way. This is what is termed running a *muck*—a practice very common among the Malays. It is not easy to explain this powerful effect of Opium on the Asiatic

and Malay races: on the European or Caucasian race it certainly never occurs. M. Charvet has attempted to account for it on the supposition that there is a greater comparative quantity of nervous matter in these races than in the European; and, consequently, that they are more susceptible of impressions on that part of the system: but, to say the least of it, this opinion is purely hypothetical.

Let us now examine the mode in which the salts of morphia operate.

Acetate of Morphia, administered in doses of a quarter to a grain, at the end of a short time, produces a sensation of fullness in the head, some obscurity of sight, tingling of the ears, cephalalgia, vertigo, a tendency to sighing, and sleep. The pupils are sometimes dilated, sometimes contracted, and occasionally not at all affected: the pulse is not much accelerated: but, after some time, if the larger dose has been taken, there is a sensation of itching all over the skin; frequently nausea; and a difficulty to pass the urine. These symptoms gradually subside, leaving behind them a slight degree of nausea, and costiveness. When a larger dose has been administered, even when it has been progressive, the cerebral excitement is alarming. In the Hospital of Pitie, in Paris, where experiments were made with this salt of morphia by M. Bailly, it was observed that sometimes, when the full dose had been taken, when the patient was in the horizontal position, he was attacked with shocks, as if he had been electrified; the head, in these convulsions, was thrown backwards; and the person, if asleep, was suddenly awoke in a state of surprise. The muscles lost much of their contractile power when the use of the medicine, in such doses, was continued for some time; and the sight was greatly impaired. In some cases, even when the nervous system was thus excited, the pulse was diminished both in force and in frequency; which led Bailly to conclude that morphia acts as a sedative on the heart, although it is a stimulant on the nervous system. It would be more consonant with truth to say that it acts as a stimulant on the nerves of sensation, and as a sedative on those of motion. Even in larger doses, in two grains, it neither augments the function of the skin, nor increases its temperature. In one

instance, however, of six grains of the acetate having been swallowed by a medical man, the sweats were so excessive that the patient was forced to change his linen nineteen times in one night. The most unaccountable, and yet the most common, symptom attendant on a large dose of the acetate of morphia, is the difficulty of passing the urine which it induces, and which cannot be overcome by any voluntary effort. There is no diminution of the secretion of the kidneys; but the difficulty seems to be seated altogether in the bladder; and it is probable that there is a general paralysis of that viscus. M. Megraux seems to think that this depends on the action of the morphia on the brain. It is more probable that the organ itself is primarily affected; as, in one case, this paralysis was removed by the application of two blisters.

In still larger doses, acetate of morphia, like opium, acts as a virulent poison. Besides the symptoms already detailed, as proceeding from the action of this salt, in an augmented degree, whilst the upper part of the body is bathed in a viscid sweat, the lower extremities are cold; there are violent nervous shakings; and the body acquires a blue or livid complexion: the face is pinched and exhibits a cadaverous aspect; and death ensues without convulsions.

The *Citrate*, the *Muriate*, and the *Sulphate*, act in a similar manner to the Acetate. The Muriate indeed affects the encephalon less than even the Acetate: its stimulant effects are obscure; its sedative very obvious.

In comparing these effects of the salts of morphia with those of opium, we are struck with their similarity, and also with some differences. In the symptoms of a large dose of *acetate* of morphia, we find neither heat of skin, no elevation of the pulse, nor any sign of the propulsion of the blood into the capillaries, as is the case when the entire opium is taken into the stomach. The accumulation of blood in the capillaries is not always absent after taking *acetate* of morphia in moderate doses: and when this occurs, the pulse is full, and the skin hot; the sweat flows in abundance, the urine is scanty and high-coloured, and costiveness occurs as when opium has been taken. It is of some importance, however, to notice the distinction between the action of *opium* and that of *acetate*

of morphia ; in order that we may be able to accommodate the action of the remedy to the state of the habit. Thus, in the cold stage of intermittents, and all cases in which there is a deficiency of blood in the capillaries, Opium in its entire state is to be preferred to the *acetate* and other salts of morphia. The stimulant property of the Opium excites the capillaries, which relieves the internal congestions and bring on sweating as a critical excretion. But *acetate* of morphia and the other salts have one great advantage over entire Opium ; they injure less the stomach and other digestive organs.

With regard to the second active constituent of Opium, *Narcotina*, as it is not soluble in the animal juices, it possesses little or no activity on the living body in the state in which it exists in Opium. In some instances, the vehicle in which Opium is administered may increase or rather bestow some activity on *narcotina* ; as, for instance, when it is dissolved in *olive oil*, or in weak *acetic acid*. In both of these vehicles it displays narcotic powers on the systems of some quadrupeds, in particular on that of the dog : but no experiments have yet correctly decided its influence on the human animal, or whether it acts as a stimulant or a sedative. The experiments of Majendie have led him to conclude that Opium contains both a stimulant and a sedative principle ; and that *narcotina* is the former : but the effects of the salts of morphia on the habit of man completely refutes this position ; as both stimulant and sedative effects result from a dose of any of them. When *narcotina* is dissolved in water acidulated with weak hydrochloric acid, it may be given to the extent of a drachm for a dose with impunity. M. Bailly, who made numerous experiments with *narcotina* in the Hôpital de la Pitié, in Paris, occasionally remarked that it produced slight nausea, some disturbance of vision, vertigo, and tremors, with an excitement of the venereal appetite in both sexes : but these were rare ; and M. Bailly on one occasion gave 120 grains of *narcotina* to a young man, who experienced only slight vertigo, which soon disappeared. The same effects of *narcotina* upon man have been observed by other physicians. In some individuals, however, of a peculiar idiosyncrasy, agitation and headache always followed its administration.

Meconic acid, as I have already stated, is perfectly inert: and when opium has been deprived of all its morphia and narcotina, the residue may be given in any quantity without risk.

We know nothing of the effects of Narceine and Meconine on the animal system.

Opium is exhibited both in the solid and in the fluid form. Let us examine the properties of its preparations, in both states, contained in the British and such of the Continental Pharmacopœias as display efficient properties.

In prescribing crude Opium, there is one disadvantage—that we never can rely on the strength of the specimen: as the season of the year, the soil, the climate, and even the mode of collecting it, modifies, in a striking degree, the properties of the drug. To obviate this, an Extract is ordered to be prepared by the London and Dublin Colleges of Physicians. The Dublin is the best, for the reasons I have already stated.

There is an acidulated extract ordered in the Brunswick Pharmacopœia, which affords a very useful mode of exhibiting the citrate of morphia in a solid form. It is prepared by dissolving four ounces of opium in forty-eight ounces of water acidulated with six ounces of lemon-juice, filtering, and evaporating to the consistence of an extract in a water bath. The citric acid in this case decomposes the meconate of morphia, and affords a more soluble salt, in combination with the gummy and extractive matter of the opium.

Another useful extract is prepared, according to a process suggested by Deyeux, by fermenting the opium in water with yeast, at a temperature favourable to fermentation; and, after the fluid has become clear, diluting it with water, and boiling until all odour is dissipated. The solution is then filtered, and evaporated to the consistence of an extract. In this case, the morphia exists in the form of an acetate; and, as several of the other constituents are sacrificed to the formation of the acetic acid by the fermentation, little more remains than the resin, a small portion of the extractive, and acetate of morphia. One grain of this extract is equivalent to gr. iss of the common aqueous extract.

In noticing the extracts, I may mention a preparation which the Chinese make for the purpose of smoking; it is called *Chandoo**, and appears to be merely a very carefully prepared gummy extract. The Chinese smoke it in the same manner we do tobacco; and receive from its use a feeling of calm enjoyment, which is peculiarly grateful to them. I am much disposed to think it might prove useful in affections of the lungs; for instance, spasmodic asthma, and, perhaps, even in phthisis; but I have had no experience of its effects on the animal frame when used in this manner.

The quantity of Opium contained in the

Pulvis Cornu usti c. opio, the dose of which is gr. x. to ʒss, is $\frac{1}{10}$

—— Cretæ comp. cum opio, —— gr. v. to gr. 40, $\frac{1}{40}$

—— Kino comp. —— gr. v. to ʒi, $\frac{1}{20}$

—— Ipecac. comp. —— gr. v. to ʒi, $\frac{1}{10}$

In the three first of these preparations the power of the Opium is greatly weakened by the chemical influence of the chalk and the kino upon the meconate of morphia which it contains. They should never be added to aqueous infusions or solutions. Vogler has proposed a preparation of the compound powder of ipecacuanha, which might be advantage-

* *Method of preparing Chandoo by the Chinese.*—A ball of Patna opium weighing 3lb. 10½oz. is divided into two equal parts; the whole of the soft part of the opium is carefully removed from the two sections, and put into a separate vessel; the inner layers are to be peeled off in shreds, and put into a vessel resembling our skillet, with about a quart of cold water, and boiled. While boiling, the mixture is to be stirred with a large wooden spatula, without intermission, until the whole is of the consistence of a soft pulp, or smooth paste. The soft opium is then added to the mass, and continued on a brisk fire until it acquire the consistence of extract of opium of the shops. The whole is then to be removed, equally divided, and spread very evenly on the interior surface of two shallow vessels, which are inverted over a *very gentle fire*, for the purpose of evaporating it to dryness (this part of the process would probably be better conducted in an oven); when sufficiently dry, the whole mass is reduced to powder. The powdered ingredient is then to be mixed with repeated portions of filtered boiling water, until it pass through colourless, and the filtered aqueous solution again evaporated with the aid of a brisk coal fire, in a deep copper vessel, to the consistence of good treacle. This very pure extract has a smooth uniform appearance, like a transparent jelly, with a sweetish and rather agreeable odour, resembling soft extract of gentian. The whole process being gone through, it should yield 1lb. ʒxii and ʒvi, or very nearly 50 per cent. of the original weight of the ball employed.

ously introduced into the British Pharmacopœias, for some particular cases, as a convenient mode of giving a combination of opium and ipecacuanha in children's diseases. He orders one grain of ipecacuanha, two grains of opium, one drachm of nitre, and ʒi of bitartrate of potassa in fʒiv of water of acacia flowers, and fʒiv of the syrup of the red poppy. I have been in the habit of prescribing a mixture containing fʒii of ipecacuanha wine, the same quantity of tincture of opium, ʒiiss of nitrate of potassa; fʒiv of lemon juice, or solution of citric acid, and fʒiv of camphor mixture, as a liquid Dover's powder. Two table-spoonfuls of this mixture are equal to gr. x of the compound powder of ipecacuanha, and more certain to produce diaphoresis. I may here mention that the original powder of Dr. Dover contained nitre.

The *Pilulæ Saponis cum opio*, contain $\frac{1}{3}$ of opium; its dose is gr. iii to gr. x.

Confectio Opii contains $\frac{1}{36}$ of opium; its dose is gr. x to ʒss.

Nothing can be more injudicious than the usual method of prescribing this confection with astringent mixtures; a tannate of Morphia, which is inert, being thrown down, so that the mixture remains merely a compound of aromatics and astringent matter; without possessing any narcotic influence.

The *Tinctura Opii* contains $\frac{1}{9}$ of opium; its dose is m. xix to fʒi.

——— *Opii Ammoniata*, E.

No preparation displays less chemical knowledge than this: instead of the full proportion of Morphia in the quantity of Opium employed, the preparation contains only as much as weak spirit can take up; the Opium being decomposed by the ammonia, and a meconate of that salt formed, which is retained in solution whilst the Morphia is thrown down.

The *Tinctura Camphoræ composita* contains gr. ii of Opium in fʒi of the tincture; its dose is fʒi to fʒiv.

Vinum Opii — fʒi contains gr. iii of opium—but the opium in the present preparation is undoubtedly in a less active state than in the old preparation, when wine was the vehicle, owing to the tartaric and acetic acids contained in the

wine. The cinnamon and cloves are bad additions, as they partially decompose the salts of Morphia: but were the oil of cinnamon and of cloves used instead of the cinnamon and the cloves, the preparation would be a valuable medicine in cases in which a combination of stimulants and Narcotics is indicated. The usual dose is from m. x to fʒi.

Laudanum Liquidum Sydenhami, is the original of the Vinum Opii, with double the quantity of opium; and with wine as the menstruum. One fluid drachm contains gr. x of Opium: and, under all circumstances, it is a preferable preparation to the Vinum Opii, improperly so termed, of the present Pharmacopœia.

Linimentum Opii et Saponis, E. D. possesses no advantage over the extemporaneous addition of Tincture of Opium to the soap liniment. It is a useful external application.

Extractum Papaveris is merely an inferior preparation of the gummy extract.

Syrupus Papaveris albi is a bad preparation, owing to the uncertainty of its strength. It acquires more active properties when it ferments.

Black Drop.—This preparation was made upwards of one hundred years since, by Edward Runstall of Bishop Auckland, in the county of Durham. It has been stated by the late Dr. Armstrong and others, that it is prepared by slicing half a pound of Opium, and boiling it, in conjunction with an ounce and a half of nutmegs and half an ounce of saffron, in four pounds of verjuice; then adding a quarter of a pound of sugar and two table-spoonfuls of yeast. This compound is allowed to ferment for six weeks in a warm place; after which it is decanted, filtered, and bottled, adding a little sugar to each bottle. Were this recipe correct, it is evident that the black drop would contain an acidulous acetate of Morphia, which is the case, as the drop, when diluted with water, and tested with litmus, displays acid properties: it is effected by most of the usual tests of the tinctures, and other preparations of Opium; and indicates the presence of Morphia by nitric acid and permuriate of iron. The nature of this preparation is, however, yet unknown: it is much more powerful as a narcotic than the officinal tincture, three drops of which are only equal to one drop of the Black Drop.

Battley's Sedative Solution.—I am inclined to believe that this preparation contains acetate of Morphia, the resin and extractive being separated; but this opinion is merely conjectural, as the preparation is kept secret. It does not exceed the officinal tincture in strength, and its only advantage is, that it is less stimulant.

Acetum Opii. Dub. prepared by macerating four ounces of Opium, rubbed to a pulp, in a pint of distilled vinegar, for seven days, with frequent agitation and filtering. This is a simple solution of acetate of Morphia, in a most convenient form for medicinal purposes. It contains the gummy matter of the opium and the colouring principle, which are no disadvantage. The dose is from twelve to fifteen drops; being stronger than the officinal tincture in the proportion of three to two.

Of all the salts of Morphia, in my opinion the muriate is the best and the most certain in its effects. They may all be extemporaneously formed. Thus, by adding the common tincture of Opium to mixtures containing either the sulphuric, muriatic, acetic, or citric acid, we obtain solutions of salts of Morphia. In employing the ready-formed salts, it is necessary, in adding other saline constituents, to be aware of those which are likely to decompose the salts employed. If, for instance, we wish to combine a salt of baryta with a salt of Morphia, we must adopt the muriate, and avoid employing the sulphate; if with the nitrate of silver, the muriate must not be selected. We may prescribe the citrate with lime-water.

Many of these salts have been employed in their impure state, in the form of tincture: thus, as I have already remarked, Battley's Sedative Solution may be regarded as an impure acetate in solution. A citrated tincture has also been employed from a suggestion of Mr. Potter, of Bristol; and I have lately suggested a tincture of the muriate which has the advantage of containing no narcotina, and may be combined with many of the alkaline and some of the metallic salts, without suffering decomposition. It appears to operate with more certainty than Battley's Sedative; and does not affect the head nor constipate the bowels.

Such are the various preparations of Opium. Some of

them are most unchemical, and defeat the object for which they are intended : these ought to be rejected from the Pharmacopœias.

With respect to the remedial employment of Opium, we must always keep in view both its stimulant and sedative effects ; and in those diseases in which the first would be injurious, whilst, at the same time, the second is required, we ought not to administer it until the previous excitement is subdued by bleeding and other means.

In intermittent fevers the best period for administering Opium is that recommended by Sydenham—an hour before the expected paroxysm : it weakens the force of the attack and sometimes prevents it altogether. This result is probably due to its stimulant quality : the dose should, therefore, be large ; from forty to sixty minims. As it increases the cutaneous function, Lind recommended it to be given during the hot stage also ; and experience has not shewn that any disadvantage attends this practice, except in plethoric habits and in cases in which a tendency to inflammatory action exists. It not only renders the hot stage shorter and milder, but, also, tends to lengthen the intermission ; and greatly promotes the influence of bark, and that of sulphate of quinia. I have found it a most useful addition to calomel in obstinate tertians, which resisted the bark, sulphate of quinia, and arsenic. A pill, containing one grain of calomel and one of opium, taken at bed time, has generally, in a very few days, enabled the bark to operate efficaciously, and to cure the disease, on which it previously had exerted no power. Dr. J. Clark, in his *Treatise on the Diseases of Long Voyages*, states that he found Opium most useful in the remittent and intermittent fever of Bengal, “by taking off inquietude, inducing sleep, and by bringing on perspiration :” and not less so in continued fever, by raising the spirits and procuring sleep ; and, when given early, that it prevented delirium. After full evacuations, he generally gave a large dose of Opium, as a preparation for the immediate use of cinchona ; and he continued the exhibition of calomel and Opium, at bed time, as an addition to the bark.

With regard to the rationale of the use of Opium in inter-

mittents, its efficacy in preventing the accession of the paroxysm is certainly due to its stimulant property; which, by exciting the action of the heart and arterial system, prevents that congestion which takes place on the accession of the paroxysm. But, as the repetition of it tends to produce debility, it should not be given in successive paroxysms, if it fail to check the accession.

In continued fevers the propriety of administering Opium is questioned by many. In the acute form of fever, its use is at least doubtful. If required to allay pain, or to procure sleep, it should be given in full doses, and in combination with calomel and tartar emetic; in which state of combination, its stimulant properties are scarcely perceptible: but even under these circumstances it should not be prescribed if the temperature of the surface exceed much the natural state: but, when there is a tendency to perspiration, it accelerates this, and undoubtedly proves beneficial. Dr. Currie used it with advantage after the cold affusion; and it is still more useful if it be combined with calomel and James's powder. In the more advanced stages of continued fever—both in typhus and in the synochus of Cullen—it was formerly administered as a general stimulant, in doses of from six to ten minims of the tincture, or in half these doses of the black drop, in combination with camphor and other cordials; but this practice is now discontinued. When the fever is a synochus, it is difficult to fix exactly the point of time for the administration of Opium. In the first stage of this disease, the pulse is full and hard, the heat is greater than natural, the thirst is considerable, and, if there be any derangement of the mental powers, its use is generally accompanied with extreme headache. In this state of the system Opium is not admissible; but in the second stage of the disease, when debility supervenes, it may be given with advantage, and is strongly recommended by Lind, Blane, and others. Opium, however, as a general stimulant is inferior to wine when it can be procured, which is always to be preferred in the sinking stage of this fever, being more permanent in its effects. In typhus, the symptoms that chiefly indicate the use of Opium are watchfulness, diarrhœa, and subsultus tendi-

num ; but if delirium be present it must be recollected that this may be the consequence of high cerebral excitement, or the sthenic diathesis, as it is termed, as well as of debility ; and it is necessary to distinguish between these states in administering Opium. It should not be given if the delirium be accompanied by flushing of the face, impatience of light, or throbbing of the temples. If, however, there be much low-muttering delirium, which has been preceded by an unusual inattention, Opium, in combination with ammonia, is to be preferred to wine ; it is also to be preferred in all cases attended with diarrhœa. In some habits, however, it increases instead of diminishing delirium ; in which case it ought to be either discontinued or applied, by means of friction, dissolved in oil. In whatever manner it is exhibited, the Opium in this species of delirium should be given in small doses, frequently repeated ; and, at the same time, cool air freely admitted to the chamber of the patient.

When watchfulness is the symptom for which the use of Opium is indicated in continued fever, we must, also, bear in memory that this may arise from very opposite causes ; and the advantage or disadvantage attending the exhibition of Opium depends very much upon the existence of one or the other. When the watchfulness is attended with increased heat of the surface, restlessness, or tossing about in the bed, and determination of blood to the head, Opium proves highly injurious ; instead of it, bleeding and the other antiphlogistic means, with the local application of cold to the head, are more likely to prove beneficial. But if the opposite state of the case exist, then Opium is the best remedy. For promoting sleep, under these circumstances, it should be given in full doses, and at the usual time of rest, that is, in the evening. As my friend, Dr. Tweedie, in his *Clinical Illustrations*, remarks, it should be a full dose of *solid* opium combined with calomel ; and during its administration the scalp should be enveloped in a cloth wet with a cold lotion.

Diarrhœa is another symptom for which the use of Opium is indicated in continued fever ; and when it arises from irritability and relaxation of the whole system, it is undoubtedly the best remedy.

The most advantageous form for administering Opium in continued fevers is that of spirituous or vinous solution ; the quantity can be better determined and regulated ; thence the tincture of the Pharmacopœia, the sedative solution of Battley, and the vinum opii, or the laudanum of Sydenham, are the best forms of preparation. Many circumstances may occur to vary the extent of the dose ; but it may be regarded as a general rule, that it should be double that which the patient requires to produce sleep in a state of health. Opium is usually combined in this case with etherial preparations : as, for instance, the compound spirit of sulphuric ether of the Pharmacopœia ; but it is, perhaps, always more likely to prove beneficial when given alone. In cases in which the individuals are apt to suffer from Opium in its entire state, either in the solid or the fluid form, the salts of Morphia, especially the *muriate* or the *acetate*, may be advantageously employed.

Inflammation is both active and passive. In the former, Opium has been employed ; but it requires to be administered with great caution, as it is apt to accelerate the progress of gangrene. In gangrene, however, of one description, that which is termed dry gangrene, which affects the toes and gradually extends to the feet and limbs, Opium may be regarded as the sheet anchor ; but this affection probably depends on inflammation of the passive kind. Passive inflammation, also, may arise from both general and local debility ; and in many instances of the phlegmasiæ we find it to be of the latter kind ; for example, in malignant, ulcerated sore throat and in chronic rheumatism. But even when the inflammation is of an active kind, as in pleurisy, if venæsection be freely employed, I know of no method of subduing it so rapidly and certainly as the administration of a large dose of Opium, from one grain to three grains, according to circumstances, given in combination with calomel and tartar emetic, immediately after the bleeding. When the inflammation is in the substance of the lungs, as soon as the dyspnœa, the difficulty of breathing, has been subdued by bleedings, which should be repeated until this is effected ; when the urgent symptoms are reduced to cough and want of sleep, then, as Cullen has judiciously pointed out, Opium may be exhibited

with the greatest advantage. The quantity of Opium, in this case, should be sufficient to ensure its sedative effect; and it is always requisite to combine it with tartar emetic or other antimonials, so as to determine to the surface; and the further addition of calomel, as recommended by Dr. Hamilton, of Lynn Regis, never fails to aid its sudorific effect. All acute affections of the chest are relieved by the use of Opium, thus preceded by the antiphlogistic treatment; indeed, this is essential in all, with the exception of catarrh, which may be at any time checked, in the commencement, by an opiate combined with an antimonial taken at bed time. It seldom, in this case, produces diaphoresis; and, generally, arrests the disease more certainly when this does not occur: but if the disease be fully formed, this mode of giving Opium is more likely to prove hurtful than beneficial.

In peripneumonia notha—that state of pulmonary inflammation in which there is a greater flow of humours into the lungs than in common inflammation of these organs—both in that variety which constitutes the catarrhus suffocativus of old age, and, also, in that which is characterized by congestion of blood in the pulmonary vessels, Opium is useful. In the first, it may be combined with ammoniacum and squill; and, in the second, after a judicious abstraction of blood, the liberal administration of Opium, in combination with stimulants, and in conjunction with cupping and blisters, has been productive of the greatest benefit. This statement may be regarded as at variance with the opinion that Opium prevents or restrains expectoration. Now, let us examine briefly the ground on which the opinion of the efficacy of Opium in Pneumonic affections is built. What is the state of the chest? We find that the pain is aggravated by a full dilatation of the chest, consequently that a perfect inspiration is not procured, and that even this, imperfect as it is, must be procured in the erect posture. Now, in this state of the respiration, the necessary change cannot be effected on the blood; and, in the irritable state of the bronchial membrane, the secretion is hurried, and the sputa consequently thin and irritating. Under these circumstances, if Opium taken into the stomach, through its influence on the pneumogastric nerves, and its power of allaying pain, admit

of a fuller and more perfect inspiration, it is easy to comprehend that the thicker and more slowly secreted mucus will be coughed up more easily than thinner and irritating matters. Thence, Opium, instead of restraining, will promote expectoration.

In ophthalmia, Opium may be internally administered under the same restrictions as in Pneumonia; and it is admissible in full doses when the pain and irritation are excessive, even before venæsection has been resorted to, if it be combined with calomel and tartar emetic. Externally, no application is more useful, after the inflammatory action has been subdued by topical bleeding; and from the commencement, when the inflammation is of a passive kind. The *Vinum Opii* of the London Pharmacopœia is used for this purpose; but it is less serviceable than the old *Solutio Opii Vinosa*, as it contains only half the quantity of Opium. The liquid laudanum of Sydenham is admirably adapted for this purpose. It is dropped into the eye, and acts partly by inducing a new and more healthy action in the organ, and partly by its sedative influence in allaying irritation.

In rheumatic affections, even in the acute form of the disease, Opium is now more employed than formerly, and the use of the lancet thereby superseded. My opinion on this subject is founded upon the following grounds: 1. That the inflammation of rheumatism differs from that which is termed phlegmonous, both in its progress, which is often intermittent, and its termination, which is never in suppuration nor in gangrene. 2. That the pain often continues after the pulse is brought considerably below the natural standard. 3. That experience has not demonstrated the advantages of loss of blood, but has rather demonstrated that it can only be used as a pre-fatory measure to the use of Opium: and 4. That, when health has been restored, after much blood-letting, the affected part has remained very irritable, and the general habit in a weak or an atonic condition. On the contrary, Opium, when employed so as to determine to the surface, aiding its action by external warmth and copious dilution, has cured the disease, and left the habit in a better state than it enjoyed previous

to the attack. It is always proper to purge first, then to repeat the dose of Opium every third or fourth hour.

With regard to chronic rheumatism, there can be only one opinion as to the utility of Opium: it is an excellent addition to the bark, or, what, in my opinion, is much preferable in this variety of rheumatism, the infusion of the *Menyanthes trifoliata*.

In gout, physicians have now dropped the idea that pain, which seems truly to indicate the use of Opium, should not be put down by it, and are convinced that patience and flannel alone are not likely to cure the disease. Even in that variety of the disease which is termed retrocedent gout, Opium is truly our sheet anchor; and it must be given in full doses. In some cases, ten grains have been administered twice a day with advantage; and, when the necessity of administering it is over, no disadvantage is felt by the constitution if the dose be not too hastily let down. In the acute form of the disease, Opium has been judiciously combined with colchicum. This is not the moment to enter into an examination of the value of colchicum and of the nature of its action; but I may venture to say, that more is due to its purgative quality and to its power of emptying the liver by powerfully stimulating the gall-ducts and the duodenum, than to its supposed narcotic or specific influence in gout. It has been supposed that Opium diminishes or stops the biliary secretions, because frequently the evacuations, after a dose of Opium, become pale; but this only proves a diminished excretion. In the lower animals poisoned by Opium the gall-bladder and ducts have been found turgid with bile, although very little had found its way into the duodenum. Now, if colchicum stimulates the gall-ducts, the combination of this remedy with Opium sets aside the objections made to Opium in gout as far as the biliary secretion is concerned.

It is almost unnecessary to state that, in cases of biliary calculi and in nephritic inflammation arising from the irritation of calculi in the pelvis of the kidney, or in their passage from the kidney to the bladder, the best results are obtained from the use of Opium. In these cases, particularly when a cal-

culus is passing along the ureters, the stomach is so irritable that it quickly rejects every thing received into it: in this case, and also on account of the advantages of proximity in the local influence of medicines, more benefit is derived from administering the Opium per anum, in the form of enema, dissolved in oil, than from giving it by the mouth. In suppressions of urine, also, from calculi irritating the bladder, Opium, in combination with calomel, is the remedy chiefly to be relied upon. The same combination has been found powerfully anodyne in the chordee and painful micturition of gonorrhœa virulenta. This practice originated with the success obtained by Dr. Hamilton, of King's Lynn, Norfolk, from the employment of Opium, in this combination, in suppression of urine from strictures. Large doses of Opium do not produce the same effects; nor does calomel alone: it is from the combined influence of both that the salutary effect proceeds. The most common mode of administering Opium and calomel to relieve this symptom of gonorrhœa is to give two grains of each in the form of pill every second or third hour. I have been most successful when I ordered from six to eight grains of the calomel and two of Opium once in eight hours.

Smallpox is the disease, among the exanthemata, in which Opium is most decidedly indicated; and it is to the sagacity of Sydenham, relying on observation and rejecting theory, that we owe this fact. In distinct smallpox, he gave laudanum on the fourth day. This is a practice, however, which, in the majority of instances of this form of disease, is not at all required; but, when convulsions occur, or when the eruptive fever is accompanied with much restlessness, Opium must be administered. In confluent smallpox, Sydenham deemed Opium a specific; and, to an adult, he gave it until the eruption was completed. He generally commenced with eighteen minims of his liquid laudanum, which are equal to twenty-five minims of the tincture of the Pharmacopœia; and this was repeated every night until the tenth day, when he gave an ounce and a half of his Syrupus Meconii, a preparation resembling syrup of poppies, in the evening, and an ounce in the morning, daily, for some days. He usually moderated the dose if it checked the diarrhœa, which he consi-

dered necessary to carry off the dregs of the complaint. Although in confluent smallpox the eruptive fever is of an inflammatory type, yet the epileptic fits that precede the eruption are always alarming: and, as by exhausting the strength they increase the debility, and therefore ought to be arrested as soon as possible, Opium must be exhibited, and in large doses frequently repeated. The form of enema is perhaps the best in this case; and it operates, if not as powerfully, at least as rapidly, when thrown into the rectum as when taken into the stomach. But, during the continuance of the eruption, in the majority of cases, the use of Opium is not required, although it may be occasionally necessary to promote the maturation of the pustules. After the eruption, however, Opium is indicated, under the same circumstances as in typhus fever, in conjunction with bark and wine. It is also useful in the secondary fever, under some circumstances, as, for instance, when diarrhœa supervenes, which, notwithstanding the authority of Sydenham to the contrary, ought most certainly to be restrained; and, for this purpose, nothing is so useful as Opium.

In measles, the inflammatory state of the system contraindicates the employment of Opium in the commencement of the disease; but when the inflammatory state is subdued and the cough remains, then Opium, in conjunction with calomel and ipecacuanha, may be employed: and it is also required when the diarrhœa, which in moderation is useful at the close of the disease, proceeds too far. In the rubeola maligna, or black measles, as this variety of the disease attended with typhoid symptoms is usually termed, Opium may be advantageously given through the whole course of the disease; and the same rules should regulate its exhibition as in typhus.

With regard to the propriety of giving Opium in hæmorrhages there is much difference of opinion. When febrile symptoms exist, these should be reduced before administering it; and this is perhaps best accomplished by allowing the flow of blood to proceed to a certain extent. When the hæmorrhage is connected with great debility and laxity of the solids and a watery state of the blood, then Opium, in conjunction with tonics and astringents, may be immediately

administered, with the view of obviating that irritability which, in this case, is the result of laxity and weakness. But it is not always easy to distinguish between these states: hæmoptysis, for instance, occurs in both states of the habit. When no symptoms of a phlogistic or inflammatory state of the system is discoverable, when the bleeding seems to be kept up by the irritation of coughing, and when it is accompanied with watchfulness, then Opium is likely to prove beneficial. And even, in the opposite state, notwithstanding the stimulant property of Opium, if much irritation exist, it ought to be administered: but in this case it should be combined with sedatives, as acetate of lead, hydrocyanic acid, and cold, both topically and generally applied.

In phthisis pulmonalis, Opium is used to allay the cough, which is the most distressing symptom, and to moderate diarrhœa. If the accession of the hectic paroxysm be well marked, it should be given at that period. It lessens the irritation which excites the febrile symptoms. Some of the old writers, as for instance Tralles, condemn the use of Opium after the hectic is formed; although it may, he says, prove useful in the incipient stage of the disease: latter writers, more correctly, maintain that, when administered immediately before the accession of the evening paroxysm, it always diminishes its intensity. In such a case the dose should be large. With less propriety, it is generally given at bed time, when it is very apt to increase the perspirations; and on this account it is preferable to give it either early in the evening, or in the morning, when the cough is usually most severe. The advantages ascribed to some medicines given in conjunction with it are probably altogether due to the Opium. Thus Dr. Bourne prescribes *Uva Ursi* combined with small doses of Opium, with great advantage, in some cases of confirmed consumption, and ascribes the benefit wholly to the *Uva Ursi*. In this disease, the soluble salts of Morphia, especially the muriate and acetate, are preferable to the entire Opium, on account of their not exciting perspiration in small doses, such as are necessary for allaying the cough and irritation. I have found a mixture, consisting of one fourth of a grain of muriate of Morphia,

one fluid drachm of distilled vinegar, and ten fluid drachms of the decoction of Lichen Islandicus, very serviceable in this state of the disease, in allaying cough and promoting sleep, without increasing the disposition to sweating.

In no disease has Opium been more frequently employed than in dysentery ; but as to the propriety of this practice, there is much difference of opinion. In the commencement of the disease, the fæces are to be evacuated freely with calomel ; the combination of Opium with which seems to benefit by retaining the mercurial in the duodenum. If pains and tenesmus continue after this, Opium becomes necessary ; it should be combined with ipecacuanha, in order to determine to the surface : and, at the same time, it may be combined with castor oil ; as it is of importance not to allow the bowels to become confined. The intestinal canal should be evacuated once at least in twenty-four hours ; and during the intervals Opium should be administered. When the tenesmus is very urgent, the Opium may be conjoined with demulcents, in the form of enema ; and towards the close of the disease, when it degenerates, if I may be permitted the expression, into diarrhœa, Opium is then the proper remedy.

In bilious colic, and other affections of the bowels, where there is much pain and spasm, arising from highly irritating matters on the coats of the intestines, when purgatives do not act freely, Opium is advantageously united with the purgatives and with calomel. With the calomel in large doses, it allays the irritation both of the stomach and of the intestines, removes the spasm, and consequently aids the operation of purgatives. Indeed, in all spasmodic affections Opium is justly regarded as the means to be relied on for procuring relief.

In idiopathic tetanus Opium is a remedy of great power : in traumatic tetanus it is of less value, even in the largest doses ; and I am not aware of any case on record cured by its means. In my own practice I have had two cases of traumatic tetanus which have terminated successfully ; but in neither could I attribute much to the Opium employed, which was not carried to any great extent. In idiopathic tetanus, the Opium should be administered in the first period of the

disease; as the progress is very rapid, and the power of deglutition is quickly lost. The extent of dose which can be borne in this disease is enormous; and, when recovery has taken place, it has always been large. Persons unaccustomed to the use of the medicine have taken many ounces of the tincture before the least effect was produced. A case of tetanus is recorded in which fifteen hundred grains of Opium were given in seventeen days; and one in which $\text{f}\overline{\text{3}}\text{xx}$ of laudanum were swallowed in twenty-four hours: both cases were recovered. Indeed, we may persevere in the use of Opium, in this disease, to any extent, as long as it shows no particular action on the habit. In general, too little attention is paid to the progressive increase of the dose and the frequent repetition. The quantity, in the first instance, must be determined by the nature of the case: thus, if the spasms do not threaten much severity, ten minims may be given every hour; and, if no relief be afforded in three or four hours, the dose should be doubled, and so on until the benefit looked for be obtained; after which, it should be diminished in the same manner. No intermission, day nor night, should be permitted as long as the spasms continue. In some violent cases, one hundred drops have been ultimately administered every hour, with the best effect. When deglutition is impeded, it may be advantageously exhibited per anum. Solutions of the medicine in oil should, also, be applied to the surface. I have seen these oily solutions prove useful in trismus, when rubbed upon the jaw.

Opium has been extolled as a remedy in *Epilepsy*; but, as far as my own experience extends, I have never seen any advantage derived from its use, except when the disease has been kept up by habit, after the irritation which had caused the convulsions had ceased to exist. In this case, a large dose of Opium may prove beneficial, by breaking the habit. It should be administered when the paroxysm is expected, if this can be ascertained. In no disease is it of more importance to guard against the constipating property of Opium.

In *Chorea*, Opium was long regarded as the principal remedy; and Sydenham bears testimony to its influence in

checking this singular disease. If the disease be complicated with hysteria, Opium, freely administered, may produce a remission of the urgent symptoms ; and in this case, as it is of great importance to evacuate the primæ viæ, the mode of administering Opium least likely to interfere with this part of the treatment is to give it per anum. But the plan of treating chorea by powerful evacuants, and afterwards by the carbonate of iron or the nitrate of silver, is so successful, as to leave us little to regret, should Opium be altogether useless in the treatment of this disease. In another painful affection, *Tic douloureux*, we naturally look to Opium for relief. It has too frequently disappointed our hopes ; but, in one or two cases, I have seen it successful when combined with calomel and continued until ptyalism was induced. The dose should not exceed two grains, and be repeated every third or fourth hour. Opium, indeed, might be regarded as generally useful in all spasmodic diseases. But there are exceptions : thus, in Hay asthma, it augments fever, headache, and the wheezing and suffocating tightness across the chest which characterizes that disease.

The watchfulness of maniacal patients has rendered practitioners anxious to obtain the means of alleviating this distressing symptom of one of the most awful diseases which mortality is heir to ; and, from its soporific and anodyne powers, Opium, under proper management, has deservedly obtained a high reputation as an anti-maniacal remedy. The only objection to its employment in mania is its tendency to cause costiveness ; but this is obviated by combining it with aloetics, which operate on the bowels and do not interfere with the soporific power of the Opium. Its indiscriminate employment, however, has frequently been productive of much evil : for it may injure under the degree of arterial excitement which so generally prevails in insanity. Nevertheless, Opium has cut short the disease, when given in full and timely doses ; and, by procuring sleep and severing the catenation of morbid sensations, it has thus opened, as it were, “the way for the gradual return of rational perceptions*.” This effect of Opium has been particularly observable in cases of the disease arising from

* This effect of repose in forwarding the return of reason is so beautifully ex-

continued and excessive drunkenness. In these cases, there is generally a pallid countenance, a cold clamminess of the surface, and other symptoms of great debility, accompanying the want of sleep: and, under such circumstances, the question of *life* or *death* is often involved, in administering or withholding the use of Opium; and in no situation can the judgment and discrimination of the practitioner be more seriously employed. In those cases of insanity also, in which the disease becomes as it were quiescent, when all febrile heat and flushing of countenance have been subdued, Opium, properly administered, either separate or combined, will be found of infinite utility. In these cases, also, it leads the way for the more permanent use of digitalis, particularly where the corporeal functions, exhausted by the waste of vital power, become inert and feeble. There are objections, as I have stated, to Opium, owing to its constipating property: but this is not the case with some of the combinations of its active principles with other acids than the meconic; as, for instance, the acetic. Acetate of Morphia has been found most useful in the low form of insanity, and in melancholia. The dose is seldom necessary to be carried beyond half a grain.

Dr. Michaelis, the physician of the Hessian troops in the service of Great Britain, during the American war in 1779, regarded Opium as nearly a specific in all syphilitic affections; and it is curious to compare the results of his practice with those of the opposers of the employment of mercurials in the present day. He found that, when Opium was used alone, the proportion of cases cured to those not cured was as 3 to 1; and that Opium succeeded when mercury failed. He generally began with giving three grains in divided doses in the

pressed in the tragedy of Lear, that I cannot refrain from quoting the passage. Cordelia, speaking to the physician of her father, says—

What can man's wisdom

In the restoring of his bereaved sense?

PHY. There are means, madam:

Our foster nurse of Nature is Repose,

The which he lacks: that to provoke in him

Are many simples operative, whose power

Will close the eye of Anguish.

course of the day, and gradually increased the quantity to ʒss. The chief effect of these large doses was an increased secretion of urine, and, in a few cases, the production of salivation. What is remarkable, it often produced severe diarrhœa: the pulse, which at first was raised, generally soon became full and soft: it occasionally produced tremors and great depression; in which case it was abandoned. In the perusal of these details by Dr. Michaelis, in the London Medical Communications, although the mind is not satisfied, yet one thing is evident—that much benefit may be obtained by taking advantage of the sedative power of Opium, and giving it in combination with mercury, or alone after a course of mercurial medicines, in order to allay that highly irritable state of the habit which often remains after the virus of the disease has been subdued: and we may thus sum up its good effects:—1. That it enables the system to bear a large quantity of mercury with impunity: 2. That it allays the morbid irritability which often remains after the cure of syphilis; and consequently it favors the return of health: 3. That it cannot eradicate the virus without the aid of mercury.

In diabetes mellitus, Opium has a powerful influence in restraining the quantity and moderating the saccharine quality of the urine. The dose requires to be carried to the extent of not less than six or eight grains in twenty-four hours, before the salutary effect is produced; but, too often, the evil returns as soon as the dose is diminished. In one case, recorded by Dr. Warren in the fourth volume of the Medical Transactions, five grains of solid Opium were taken four times a day, without any effect except the relief of the symptoms. Its good effect has been referred to its increasing the action of the skin, and consequently lessening that of the kidneys: but other diaphoretics do not cure diabetes; and, therefore, this explanation is not satisfactory.

Besides these complaints, Opium is generally resorted to in numerous morbid states of the system, to lessen irritation, relieve pain, and induce sleep; and, whether applied externally or taken into the stomach, its place for these purposes cannot be supplied by other substances. This frequent use of it renders it liable to be overdosed. The effects are not im-

mediately perceived ; and the period that elapses before the symptoms of poisoning display themselves varies, according to the form in which the Opium has been taken, and whether the dose has been introduced into an empty or a full stomach. If it be in the solid state, half an hour, in general, passes over before it displays its influence : if in the fluid form, the time is shorter ; unless the patient be in a state of intoxication at the moment of taking the dose. In general, the pulse is much slower than natural, but full and strong as in apoplexy : when convulsions occur, it is quick, or rather hurried, “ and does not become slow until the coma becomes pure,” as Dr. Christison properly remarks. The respiration is always slow, very rarely stertorous : the pupils are most usually much contracted and insensible. In general, the countenance is pale and ghastly ; but, in a few cases, the expression has been furious. It is quite impossible to say what quantity of Opium will poison an adult : fʒss of the tincture has proved fatal—a quantity equivalent to gr. xvi of solid Opium. Even the external application of Opium, in poultices to sores, has produced fatal effects. To afford relief in such cases, we must keep two objects in view : first, to evacuate from the stomach the Opium, when it has been swallowed, as rapidly as possible ; and, secondly, to obviate the narcotic effects which necessarily must follow, especially if it be not removed.

The first of these intentions can, now, easily be accomplished by means of the stomach pump : but, should this not be in readiness, vomiting must be excited by means of those emetics which exert a direct influence on the stomach ; such, for instance, as the sulphates of zinc and of copper, given in doses of from gr. x to gr. xxx. In promoting the action of these substances, we are directed to dilute freely : but, in my opinion, this is a dangerous practice ; as it tends to spread the narcotic poison over a greater surface, and, if absorption under any circumstances take place, to promote this and carry the poison into the system. The power of deglutition is often destroyed ; and therefore we must pass the emetic substance into the stomach through a tube, or introduce it into the veins. But the excitement of vomiting by injecting emetic substances into the veins should

never be resorted to until all other modes fail ; and, in performing the operation, the utmost care must be taken not to introduce air into the blood vessel ; as a single globule of this, arriving at the heart, may instantly prove fatal. Indeed, this practice can be justified only when the case is desperate. The second indication is answered by rousing the powers of life by administering excitants. If the torpor be so great that the patient cannot be kept in motion, artificial respiration should be resorted to, and maintained for a sufficient length of time to permit the effect of the Narcotic to pass off. Wine, ammonia, and other stimulants, even flagellation, have been employed to keep up the powers of the system in this case. But the most certain mode of rousing the system is dashing cold water on the head and breast ; which, besides awakening, as it were, the vital energy, promotes the action of emetics previously administered. In the advanced stage, some caution is requisite in using this remedy, particularly if the body be cold and the breathing imperceptible.

Among other chemical means to neutralize the Opium in the stomach, magnesia has been suggested for decomposing the meconate of Morphia, and throwing down the Morphia in an uncombined state, so as to render it nearly insoluble ; introducing ammonia at the same time to rouse the powers of the system. Infusion and tincture of galls throw down a copious precipitate of a tanno-gallate of Morphia, which has little or no activity on the animal œconomy. Orfila has therefore judiciously recommended it as an antidote. The best method of using it is to introduce a decoction of any astringent vegetable with the stomach pump. After the stomach has been fairly cleared, and no vestige of the poison left, then the mineral and vegetable acids may be advantageously administered, to subdue sickness, to relieve headache, and revive generally the patient. Under every circumstance, much depends on keeping the patient awake ; for nothing is so dangerous as to permit the least return of the sopor. He must be walked about, shaken, and roused by every means, for ten or twelve hours ; and when he is permitted to sleep, the repose must occasionally be interrupted, by dashing cold water on his head. Nothing is so likely to cause mischief as

the administration of acids, as long as any of the poison remains in the stomach; as these agents form soluble salts with the Morphia even more active than the meconate itself.

b. ATROPIA.—This is one of those alkaloids which the industry of our Continental brethren in the field of science have brought to light. It is a white, shining, saline body, crystallized in needle-form prisms, inodorous, insipid, and scarcely soluble in water or in cold alcohol, but very soluble in boiling alcohol; insoluble in ether and in oil. It is susceptible of being united with salifiable bases, and of forming neutral salts.

Atropia was first discovered by M. Brandes; and procured from the leaves of *Atropa Belladonna*, Deadly Nightshade, an indigenous plant, which flowers in June and ripens its seed in September: it belongs to the natural order Solanæ*. The following is M. Brandes' process for preparing Atropia: Bruise the mature plant, and boil it in water acidulated with sulphuric acid, then filter the decoction, and precipitate it with potassa. After washing the precipitate, treat it with sulphuric acid, and again precipitate with potassa. The product, being collected on a filter, well washed and dried, is to be submitted to the action of boiling alcohol: the evaporation of the filtered alcoholic solution furnishes pure Atropia. The sulphate crystallizes very beautifully†. M. Runge also prepared Atropia, by pouring on a solution of sulphate of magnesia just enough of the solution of potassa to decompose the sulphate, and to form a hydrate of magnesia mixed with a sulphate of potassa and magnesia, to which he added extract of belladonna mixed with water. He then evaporated the mixture to dryness, and, having reduced it to powder, treated it with boiling alcohol, which, by spontaneous evaporation, yielded the Atropia under the form of white crystals. If this salt be added to diluted sulphuric acid until it is accurately saturated, the sulphate of Atropia is formed in beautiful crystals; and in the same manner the other salts of Atropia may be procured. According to M. Brandes, the composition of the sulphate is — Atropia 38.93, Sulphuric

* Woodville's Med. Bot. 3d edit. p. 230, pl. 52. † Journ. de Pharm. vi, p. 548.

Acid 36.52, Water 24.55, = 100.00. The muriate contains 39.2 of Atropia, + 35.4 of Acid, + 25.4 of Water.

Atropia, combined with the malic acid and other constituents of the plant, is formed by the hand of Nature in the leaves, and more particularly in the seeds, of the *Atropa Belladonna*. All the parts of the plant are narcotic; whence the name of the plant, from *Atropos*, one of the Fates*. Prior to the discovery of Atropia by M. Brandes, *Belladonna* had been examined by M. Melandri and by M. Vauquelin. Melandri discovered in the leaves of the *Belladonna* a soft green resin, an animal extractive, mucus and extractive, besides binoxalate of magnesia, oxalate of lime, and muriate of potassa. In the berries he found a colouring matter, which is a sensible test of acids and alkalies. Vauquelin obtained from the juice of the plant an azotized matter, which partly coagulated by heat and partly remained in solution, owing to the presence of some free acetic acid—a bitter, nauseous matter, which, in combination with tannin, became insoluble, and yielded ammonia by destructive distillation—nitrate, muriate, sulphate, binoxalate, and acetate of potassa. M. Brandes' analysis followed that of Vauquelin; and, after Brandes', M. Peschier of Geneva examined the plant. Besides the alkaloid, he procured an acid which retained the phosphate of lime in solution and formed salts with potassa and ammonia.

The poisonous qualities of the berries of *Belladonna* have been long known. Buchanan, the Scottish historian, ascribes the victory of Macbeth over the Danes to the infusion of these berries in some ale and wine sent to Sweno during a truce. “*Vis fructui*,” he adds, “*radici ac maxime semini somnifera, et quæ in amentiam si largius sumantur.*” The intoxicating effects of the root of the plant seems also to have been formerly well known†. The symptoms of intoxication are accompanied with fits of laughter and violent gesture: these are

* Dr. Paris informs us that the specific name *Belladonna* is derived from the Italian ladies using the fruit to render their faces pale, which they regard as an aid to beauty.

† In the tragedy of *Macbeth*, when the Witches vanish, Banquo is made to remark

Were such things here as we do speak about?

Or have we eaten of the *insane* root

That takes the reason prisoner?

followed by a low and feeble pulse, paralysis of the intestines, imposthotosis*, convulsions, and death. Dissection demonstrates that the stomach and intestines have been inflamed: the most rapid decomposition of the body takes place after death.

The narcotic power of belladonna is frequently advantageously taken advantage of, and the extract employed both internally and externally as a narcotic. It requires to be given in minute doses at first, and to be gradually increased until symptoms of its influence on the system become apparent. These are *dryness* of the throat, vertigo, dilatation of the pupils, slight dimness of the sight, extravagant delirium, and an eruption over the skin closely resembling that of scarlatina. In intermittent fever, in a case published by Dr. Dueres, of Marseilles, it appears to have proved successful after the sulphate of quinia had failed. Lambergen, Cullen, De Haen, Juncker, and others, employed it with advantage in the early stages of cancer. Ritcher, Munck, Mayerne, and more recently Professor Brera, speak of its use in hydrophobia! Its chief influence certainly is exerted in allaying painful and spasmodic diseases: and perhaps it has more claim to the title anodyne than any other of the narcotics. Its beneficial effects in neuralgia have been well ascertained; and in this disease the local application of the extract as a plaster over the pained part greatly obtunds the pain and adds to the comfort of the patient. It has been found useful also in mania accompanied with pain.

Dr. Golles, in a paper published in Hufeland's Journal in 1825, recommended the root as a remedy in whooping cough. He gave it in doses of one eighth of a grain, combined with a quarter of a grain of Opium, every third hour until the countenance became flushed. I have ordered the extract in doses of one eighth of a grain to a child of eight years of age, and gradually increased the dose to a quarter of a grain. Its power over the cough is extraordinary. It produces a state of the skin closely resembling scarlatina, accompanied with fever, suffused eye, dimness of sight, and frequently, although not always, headache. Whilst these symptoms con-

* A spasmodic flexion of the body forwards.

tinue, the cough remains absent; but it returns as soon as they disappear. By keeping the habit for a sufficient time under the influence of the remedy, the period of the disease has always been greatly shortened. A singular use of *Belladonna* has arisen from the circumstance of its producing the eruption alluded to: in 1807, Professor Hahneman, of Leipzig, suggested its employment as a preventive of scarlatina, and his statements have been supported by Hufeland and other German physicians. Hahneman's directions are to dissolve three grains of the extract in fʒi of cinnamon water, and to administer three drops of this solution twice a day to a child a year old; adding one drop for every year, until twelve be taken for a dose. He advises this plan to be begun at the commencement of the epidemic, and to be continued whilst it rages. Notwithstanding the seeming absurdity of expecting any effects to be produced on the system by one fifty-third of a grain of extract of *Belladonna*, even in the youngest child, this practice has been supported. Dr. Randhaken, physician of the Orphan Hospital of Langendorf in Prussia, affirms that by this means he secured safety to one hundred and sixty children exposed to the contagion: and, as I have already mentioned, Hufeland states, from his own experience, that he is able to confirm the efficacy of *Belladonna* as a preventive of scarlatina. One German physician, however, Dr. Lermann of Torgau, has stated that, in a fatal epidemic which occurred in that place in 1825, he tried the preventive powers of *Belladonna* without benefit.

The influence of *Belladonna* on the radiated fibres of the iris, led to its being proposed as a method of facilitating the extraction of the cataract by Professor Reimarus. A small quantity of the extract softened with water is to be applied upon the eyelid: it acts on the radiated fibres, dilates the pupil, and the effect continues for some time. An ointment formed with one drachm of the extract and seven drachms of lard affords great relief in hæmorrhoids, and in chordee when rubbed upon the perineum: and the powdered leaves sprinkled upon open cancerous sores abates pain.

From these effects of *Belladonna*, there can be no hesitation in admitting that it exerts a direct influence on the nervous

energy; and, under proper caution, is a narcotic of great value. It may be administered in the form of powder, in infusion, and in extract: under all these forms alkalies should not be combined with it.

Dr. Reisenger has proposed the employment of Atropia instead of the extract of Belladonna, on the ground that it exerts a direct sedative influence, whilst the primary effect of the extract is stimulant.

An overdose of Belladonna produces such an effect on the stomach that it cannot be excited to vomiting by any emetics: the advantage of the stomach pump in this case, therefore, is great. After the stomach has been relieved, vinegar is said to be the best antidote; but, previous to the use of the vinegar, I would recommend the administration of alkalies to decompose the malate of Atropia which may yet remain in the stomach: and it is not until the whole of this is evacuated that vinegar ought to be given. The cold affusion on the head and body is superior to all other means.

c. ACONITIA is the narcotic principle of all the species of the genus *Aconitum*. Many of the species of *Aconitum* are more poisonous than the *Napellus*; the most so is the *Aconitum ferox**. The Aconitia was first detected by Pallas†; and has been examined by M. Brandes, who ascertained it to be an alkaloid. It is in the form of yellow transparent needles: very bitter to the taste. Unlike the other vegetable alkaloids, it is soluble in cold water; but scarcely so in cold alcohol, although very soluble in boiling alcohol.

The plant which yields this principle is a native of the North of Europe, belonging to the natural order Ranunculaceæ‡. It is not the *Napellus*, but, as De Candolle has accurately determined, the *Paniculatum*, or rather a variety of that species, which he has named *Stoërkianum*, to distinguish it as the plant which was introduced into practice by Stoërck.

* A species figured by my friend Dr. Wallich, in his splendid work *Plantæ Rariores Asiaticæ*. It is used often by the natives of India to poison tanks of water, to check the progress of an army. This attempt, says Dr. Wallich, was actually made in the Nepal war, at Hotoura; but it was discovered in time to save the soldiers. It is also used for poisoning arrows.

† Journ. Chirurg. Med. t. i, p. 194.

‡ Woodville's Med. Bot. third edit. p. 461, pl. 165. Lond. Dispens. art. *Aconitum*.

The whole of the genus *Aconitum* is poisonous*. The root is the most poisonous part of the plant. The powdered leaves have at first a sweetish taste, which, however, is soon followed by an acrid, burning sensation, accompanied with profuse salivation; and, if the extract of them be given without the greatest caution, it acts at first on the stomach, then on the nervous system, producing vomiting, hypercatharsis, vertigo, cold sweats, delirium, and convulsions, which terminate in death. If it be placed on the eyelids, it causes tears to flow; but it produces no sensation of heat: and when the powder is sprinkled upon an ulcer, it causes neither heat nor pain. It resembles strychnia in its effects on the posterior extremities, when administered to quadrupeds. Post-mortem dissections display few evidences of local inflammation. The poisonous effects of Aconite were confirmed on a large scale by the experiments made with it upon condemned criminals at Prague, by order of the Emperor Ferdinand I; and also at Rome, under Pope Clement VII. If it be overdosed, after emptying the stomach, either by the stomach pump or by emetics, powerful stimulants, namely, coffee, brandy, and ammonia, should be administered, and blisters applied over the stomach.

Chemical analysis has thrown little light on the medicinal properties of Aconite. The dried plant, which has been examined, often contains little active matter; at other times a great deal. M. Peschier, of Geneva, found that it contains an acid, which forms an insoluble compound with baryta; a small quantity of waxy matter; phosphate, malate, and carbonate of lime: and it is owing to these salts that the infusion precipitates nitrate of silver and subacetate of lead, and all the metallic sulphates.

Notwithstanding its poisonous properties, Aconite was introduced by Stoërck as a remedy in chronic rheumatism and

* It is curious to trace the fables of the ancients in reference to this quality of the family. Ovid relates that when Hercules descended into hell to recover Alcestes, he left upon the ground, when he returned, a scum which engendered the Aconite. It was the principal ingredient in the poisonous cup that Medea prepared for Theseus; and it was the poison employed to execute the barbarous law in the Island of Ceos, which condemned to death all who were no longer useful to the state: thence the old men, who had become useless, were presented with a draught of the juice of Aconite.

other painful diseases: he also prescribed it in amauroses, scrophula, cancer, syphilis, and in intermittents; but it has never been much employed in this country. Avicenna recommended it in cases of lepra; and I have administered it with advantage in inveterate psoriasis, commencing with $\frac{1}{4}$ of a grain of the extract for a dose, and gradually carrying the dose to two grains. Busch proposed to diminish the morbid irritability and sensibility in the early stages of phthisis by Aconite. He preferred the leaves to the extract, and gave them, in a state of powder, in doses of gr. ii, every two hours, increasing the dose to a drachm daily: Portal recommends the extract in that species of phthisis which is termed rheumatic; but, from the trials of Dr. Roberts, Aconite merits no confidence in phthisis.

The only officinal preparation of this plant in the British Pharmacopœias is the inspissated juice: but, on the Continent, both tincture and wine are prepared from the seeds; and both of these preparations are not only more certain in their doses, but much better adapted for conveying the influence of this Narcotic into the habit than the inspissated juice. In every form of preparation, however, it is a medicine of extreme virulence, and requiring the utmost caution in its administration.

d. CONIA is a narcotic principle, which exists in the leaves of the *Conium maculatum*, a plant belonging to the natural order *Umbelliferæ*.*

The medicinal property of Conium is connected with the odour of the plant, which is very disagreeable, resembling that of the urine of the cat. Its narcotic principle varies greatly, according to the nature of the season and the climate in which the plant grows. Thus it is a more virulent poison in Greece, Italy, and Spain, than in England: and this is so very striking, as far as concerns locality, that we are informed by M. Steven, a Russian botanist, that the Russian peasants eat it with impunity, after it has been boiled in several waters.

Schrader has given the following as the result of an analysis of the fresh leaves of Conium: in 100 parts he found of Resin 0.15, Extractive 2.73, Gum 3.52, Albumen 0.31,

* Woodville's Med. Bot. 3d edit. p. 104, pl. 42. Lond. Dispen. art. Conium.

Green Fecula 0.18, Heterogeneous mass 92.4. This heterogeneous mass was a compound of acetic acid, sulphate, hydrochlorate, and nitrate of potassa, malate and phosphate of lime, with the phosphates of iron, magnesia, and manganese. M. Brandes has obtained an alkaline principle from the leaves, to which he has given the name of *Cicutin*, or *Conin*. It is prepared by evaporating the alcoholic solution of the plant to dryness, then treating the residue with water, and adding to it magnesia. The whole being then evaporated to dryness, and the residue treated with a mixture of alcohol and ether, the *Conin* is procured by the evaporation of the filtered solution. This principle possesses the following properties—1. It furnishes a reddish precipitate with tincture of iodine: 2. it precipitates yellow the solutions of sulphate of mercury and hydrochlorate of zinc. Its action on the animal œconomy resembles that of strychnia; and the post-mortem examination of animals killed by it displays the vessels of the head, the right auricle of the heart, the vena cava superior, and the jugulars, gorged with blood: but no traces of irritation appear in the abdominal viscera.

Some years since, about twenty-five, in acting upon hemlock with ether, and evaporating the ethereal tincture on the surface of water, I obtained a rich green resinous-like substance, which possesses, in an eminent degree, the odour and taste of the recent plant; and half a grain of which produces headache and vertigo. To this principle Dr. Paris proposed to give the name of *Conein*, which I have ventured to change to *Conia*. It appears to operate in smaller doses than Brandes' principle.

Conium was introduced into modern practice by Stoërck, in the middle of the last century: but the commendations of that ardent physician have not been realized. Stoërck employed Conium in the treatment of cancer and fistulous sores. The striking defect in all his cases has been pointed out: not one of the cures was complete; and, this being the case, it is indeed surprising that they were attested by such respectable authority as Van Swieten and some other eminent men of the same period.

Many circumstances concur to alter the powers of Co-

nium as a medicine, not only as concerns the plant itself, but also the temperament and idiosyncrasy of the patient, and the nature of the diseases. As far as the medicine is concerned, much of its efficacy depends on the preparation of it. The leaves should be quickly dried in an obscure place, as light deteriorates them; the powder should also be secured from the action of light, and should be preserved in small bottles, almost hermetically closed. Infusion of hemlock is a bad form of preparation, and therefore is seldom employed. The extract, which is the form most commonly used, is prepared in two manners: the expressed juice is evaporated to the consistence of syrup, and the powder then added to bring it to a proper degree of thickness for making pills: or the green feculant part of the expressed juice is separated by the filter, and added to the other part after it has been slowly evaporated and clarified over a low fire. Now much of the efficacy of the medicine depends on the care with which these processes are conducted; the elevation of the heat in any of the steps may be sufficient to destroy the efficacy of the preparation, and, of course, the expectations of the practitioner by whom it is employed. It would also be advantageous were the plant, for medicinal use, collected in the south of Europe; dried in an obscure place, without heat; powdered and sent to this country, and to other parts in the north of Europe, in well packed tin canisters. By such means, if no adulteration occurred, an efficient medicine would be obtained.

With respect to the state of the patient, Conium affects those of a melancholic temperament much less than those of a sanguine; and in few instances does idiosyncrasy so interfere with the operation of remedies as with that of Conium. These circumstances, therefore, not only tend to perplex the practitioner, but to produce very varying opinions respecting the general powers of the medicine. Keeping these facts in view, let us briefly enquire in what diseases Conium is most useful. As a narcotic, it has been found useful in acute rheumatism, in scrophula, syphilis, and cancer, the pain and irritation of which are supposed to be more effectually under the controul of Conium than of any other remedy. In these

cases, the dose should be gradually increased until symptoms of poisoning begin to display themselves. These are nausea, dimness of sight, headache, drowsiness, vertigo, acceleration of the pulse, sweating, dryness of the mouth, diarrhoea, and sometimes, though rarely, constipation of the bowels. These symptoms are not all invariably present, in all cases, nor even in the same patients at different periods; but this rule almost constantly holds, that some of these sensible effects of the influence of the medicine must present themselves before any perceptible change in any of the diseases which I have enumerated can be excepted. In the greater number of cases in which Conium has been fairly tried and proved beneficial, the cure proceeded in the direct ratio of these sensible effects. It is on this account that the medicine requires to be begun in small doses, and progressively increased until the sensible effects of its power be sufficiently obvious. The pulse is often very peculiarly affected, being in some instances sunk, in others maintained at a hundred or more during the whole time of exhibiting the medicine. The urine is sometimes much augmented in quantity; sometimes it is scanty, and the cutaneous excretion increased; sometimes little alteration is produced on the sensibility of the habit; but, occasionally, this is greatly diminished.

Conium has been advantageously employed in all diseases connected with nervous irritability: in hooping cough it is preferable to opium for allaying the cough; but neither, in my opinion, are much to be relied upon in that spasmodic affection. It has been, also, beneficially employed in that variety of paralysis which is complicated with rheumatism, in which the deficiency of motion is attended with acute pain. I have had no opportunity of watching the effects of Conium in this disease; but Dr. Home, when professor of *Materia Medica* in Edinburgh, used to mention, in his lectures, six cases in which he gave the remedy a fair trial; two were of long standing and one of these in an old person. The medicine was carried to the utmost point; three of the cases were relieved and three were cured. In chronic rheumatism I have witnessed much benefit result from its administration: even when the disease is not removed, the pains,

in general, are kept under. In chronic sciatica I have seen it produce more beneficial effects than any other medicine.

In those headaches which assume a periodical character, Conium in combination with tonics, particularly sulphate of quinia and arsenic, is generally productive of much benefit. Its *modus operandi* in these cases is not always clear; but it must be taken into account, that few diseases assume a more Protean form, and in few are the causes more obscure. In scrophulous affections, the diseases for the relief of which Stoërck chiefly vaunted the influence of Conium, I have not been able to perceive that it effects more than any other narcotic, whether internally administered or externally applied; and in phthisis, except in allaying the cough, I may pass the same sentence upon it, as far as my experience has enabled me to judge of its power. Conium affects powerfully the genitals, on which account it has been prescribed in cases of impotency in Germany*.

Upon the whole, I feel authorized to say of Conium, that it is a medicine of considerable power; that, if due attention be given to prepare it, so that its strength may always be uniform, in the same form of preparation, and if the doses of the medicine be carried to their utmost extent, it merits more attention than has hitherto been paid to it by British practitioners.

When Conium has been overdosed and acts as a poison, its effects greatly resemble those caused by opium. It first produces giddiness and headache, which are followed by drowsiness, so intense that the patients fall asleep whilst they are conversing: coma and convulsions follow, and, if proper means be not taken to obviate the fatal result, death rapidly ensues. Post-mortem examinations of the body display great turgidity of the vessels of the head, and a remarkable fluid state of the blood, which appears to depend on some chemical influence of the Conium, as a small portion of the infusion prevents fresh-drawn blood from coagulating. The same effects are produced by the etherial extract, which I have

* “*Impotentiam virilem sub usu Conii curatam observavi, in viro quodam plusquam quadragenario, qui omnem erectionem penis prediderat, postinde tamen plures liberas procreavit,*” says Bergius, an author of great credit.

named Conia ; but as Brandes' *conin* operates more like strychnia, the mind is left in doubt regarding the real nature of the active principle of Conium. When Conium has been taken with the view of poisoning, vinegar and vegetable acids are the best antidotes, as they greatly diminish its energy. The extract of the recent plant is the only preparation of Conium in the London Pharmacopœia, and it is objectionable, owing to the difficulty of preserving it. Whenever a saline effervescence appears on the surface, this extract is of no value. The best form of preparation is the tincture, of the Edinburgh and the Dublin Colleges. The dose of the extract is from i gr. to vi gr., but it may be gradually carried to half a drachm ; and its good effects are seldom evident until it be carried to this length, and continued for some weeks. Much comfort has, also, been procured by applying the extract as a topical dressing to cancerous sores. The dose of the tincture is from m. x to m. xxx in any vehicle except one of an acid nature, which destroys its narcotic power. The tincture may be advantageously added to an emulsion of bitter almonds, containing the wine of ipecacuanha, in catarrhal coughs, and in spasmodic asthma. I have seen great benefit derived from Conium combined with hydrocyanic acid, in a decoction of Cetraria Islandica, in cases of long-protracted hooping cough, when much debility was present. In many other obstinate coughs, Conium is productive of much advantage, lessening the frequency and the force of the cough, and calming the general disturbance in the system.

Conium, when operating as a poison, affects chiefly the respiratory function ; the breathing becoming constricted and laborious ; the pulse small, and beating scarcely thirty in the minute ; the extremities become cold, the countenance bloated, bluish, and turgid with blood, like that of a man in the act of strangulation. The most prompt means of abstracting the poison from the stomach must be resorted to ; and, if the stomach-pump be not at hand, the strongest direct emetics should be administered. I am not aware that any means have been suggested of acting chemically upon the poison.

e. DATURIA.—This is the active principle of the *Datura Stramonium*, a plant belonging to the natural order Solanææ, a native of America, now naturalized to our soil*. The whole plant has a strong narcotic odour and a bitter nauseous taste, and imparts a green tinge to the saliva when it is chewed.

The *Daturia* is also found, in combination with malic acid, in the seeds of the *Datura Stramonium*, and some other species of the same family. It is procured by macerating the seeds in boiling alcohol, decomposing the malate thus taken up by magnesia, and again treating the precipitate with alcohol, which by evaporation deposits the *Daturia*. It is almost insoluble in water and in cold alcohol, but is soluble in boiling alcohol, and forms soluble salts when united with acids. It was discovered by M. Brandes, and is justly regarded as the active narcotic principle of *Stramonium*.

Stramonium has been analyzed by Wedenberg, who found that it contains mucus, resin, a small proportion of a volatile matter, and the narcotic principle. I find that the volatile matter is carbonate of ammonia, and that it also contains a small proportion of tannin.

In a more recent analysis, Promnitz found, in 200 parts of it, 58 of extractive, 6 of chlorophylle, 64 of albumen, 15 of resin, 12 of phosphate of lime and magnesia, and 45 of lignin or woody matter.

The narcotic properties of some of the species of *Datura* have been long known in the East. It has always been smoked in Ceylon to relieve asthma; the poorer Turks use it instead of opium; and the Chinese infuse it in beer, to produce intoxication. In the Carnatic, the native practitioners use the *Datura fastuosa* in all painful affections, even in cancer. The Arabians were early acquainted with the narcotic powers of this species, the *Stramonium*, and employed it both as a poison and as a medicine. Its influence on the animal system so closely resembles that of belladonna, that it is scarcely necessary to enter into details. Indeed, so closely does it resemble belladonna, that even, in the intoxication

* Woodville's Med. Bot. 3rd edition, p. 197, pl. 74. London Dispensatory, art. *Datura*.

which it produces, the same follies are committed. In some parts of Europe, this effect of the plant is so well known that it is vulgarly called “Herbe aux Sorciers.”

It is given in the form of extract and of tincture. The former varies greatly, according to the mode of preparation, and therefore is an uncertain form of the medicine. Prepared in vacuo, Dr. Marcet found it extremely useful in sciatica, in doses of from $\frac{1}{8}$ of a grain to a grain; and Dr. John Davy bears testimony to its value in chronic coughs which have nightly exacerbations. I have had no experience of the extract, but have used the tincture of the seeds, and find it a valuable Narcotic. $\mathfrak{z}\text{ii}$ of the bruised seeds are digested in $\mathfrak{f}\mathfrak{z}\text{xvi}$ of alcohol for six days, and filtered. The dose is from m. x to m. xx. The dose of the extract, if well prepared, should not exceed gr. ss at first, but it may be gradually extended to gr. vi. In the minimum dose I have found it extremely useful in case of uterine irritation, and in cases of painful menstruation, in combination with Plummer's pill and foxglove. M. Kirchoff, a French surgeon, states that, by rubbing this tincture on the part affected with neuralgia fifteen times a day, and continuing this for some time after the pain is relieved, he has succeeded in completely curing this painful disease. The same practitioner, and Dr. Englehart of Utrecht, have found it equally efficacious in all the cases in which belladonna is useful.

In overdoses Stramonium operates as a poison. The determination to the head, which follows, points out the necessity of blood-letting. This, however, does not interfere with the evacuation of the stomach and bowels, which is, under every circumstance, essential. When death ensues, the post-mortem examination displays congestion of the brain; and, in a case recorded by Haller, extravasation into the ventricles had taken place. When death does not ensue, a very troublesome itching remains for some time after the effects of the poison are subdued.

f. DIGITALIA.—This saline substance is conjectured to be the active principle of the leaves of the *Digitalis purpurea*, or Foxglove; but it is probably a compound substance, and the product of the process by which it is procured. The

determination of this point is, fortunately, a matter of little moment, as the leaves of the foxglove, when properly dried and well preserved, are active in such small quantity, that little benefit would result from a separation of their active agent.

Digitalis purpurea is a plant belonging to the natural order Scrophularineæ*.

It is a biennial plant, very common on elevated ground, where the soil is dry, sandy, and gravelly.

The beauty of the foxglove has given it a place in gardens; but the properties of the plant as a medicinal agent are much deteriorated by cultivation. The best plants for medicinal use are those which grow on elevated situations and exposed to the sun. The leaves should be gathered before the plant flowers.

When $\frac{3}{4}$ of the leaves of foxglove are acted on by alcohol, the spirit takes up about gr. xx, and leaves, on evaporation, a green matter, resembling tallow in consistence, but rather more tenacious, and having a disagreeable, virulent smell. It does not furnish ammonia by distillation, and is not acted upon by acids. This is not Digitalia, which is a brown, pitchy, dequescent substance, capable of being crystallized, but not affording regular crystals, and scarcely ever obtained in the crystalline state. It is intensely bitter, and seems to possess all the activity of the plant in an eminent degree. This substance is extracted from the dried leaves by acting on them with ether, both cold and warm, and evaporating to an extract, which is to be acted upon by distilled water, to throw down some chlorophylle. The solution which reddens litmus paper is next to be precipitated by acetate of lead, filtered, evaporated to dryness, and again acted upon by ether and evaporated: the result is Digitalia. M. Pauguy has also obtained from *Digitalis* a white chrySTALLINE substance, in fine acicular crystals, insoluble in water, but soluble in alcohol and ether; but, as it does not display any of the virtues of the plant, I shall not make any comments upon it.

* Woodville's Med. Bot. 3d edit. p. 218, pl 78. London Dispensatory, art. Digitalis.

The Pharmacopœias order an infusion and a tincture of *Digitalis*; but there is great uncertainty in both preparations, owing to the careless manner in which the leaves are frequently dried: and the only advantage of even a correct analysis of the plant would be the obtaining a vehicle which should always ensure a preparation of a definite strength. As far as my experiments enable me to decide, I am disposed to think that such a vehicle will be found in ether, which takes up the whole of the colouring matter, and, when the solution is evaporated, leaves a green principle, possessing in a high degree the properties of the plant. The solution of this in alcohol might be employed with advantage.

As a Narcotic, foxglove operates upon the nervous system, producing first stimulant, and afterwards sedative effects; for, although I was once disposed, with many others, to regard it as directly sedative, yet I have since had sufficient reason to be convinced that its primary effect is stimulant. This was first satisfactorily detected by Dr. Hallaran, in a case of insanity, in which the tincture of foxglove was given by mistake for the tincture of opium; and he concluded, from observing its action in different states of mania, that foxglove cannot be advantageously exhibited under “the pressure of high arterial action*.” This fact, indeed, had been previously noticed in employing foxglove as a diuretic; it seldom succeeded if the dropsical patient was in a state of vascular excitement; but this was ascribed to other circumstances than to the primary stimulant action of the foxglove. Dr. Hallaran, taking advantage of his discovery of this effect of *Digitalis*, employed it with great advantage as a Narcotic in cases of diminished excitement of a maniacal kind: and my own experience has enabled me fully to confirm the accuracy of Dr. Hallaran’s observations. This opinion is farther confirmed by the experiments of the Leipsick Club of Experimentalists. They found that from half a grain to gr. iii of the powder excite, directly and powerfully, the brain and the alimentary canal; and that its secondary effects, which are sedative, are evident on the circulation, which it depresses. Its influence on the brain is indicated by giddiness, dull headache, heat of

* Practical Observations on Insanity, p. 105—109.

face, dullness of sight, and intoxication : its operation on the alimentary canal by heat in the pharynx, colic, and costiveness : its secondary or sedative influence, by depression of the circulation, and a small, feeble pulse. It is only by regarding it in this point of view, that we can account for contradictory statements of practitioners respecting the effects of foxglove in diseases of excitement ; as, for example, pneumonia, phrenitis, and similar affections ; the effects of the remedy being in a great degree regulated by the period of the disease at which it is administered.

I have had several opportunities of putting this mode of employing foxglove, as a Narcotic, to the test of experience ; and when proper measures were taken to unload the system, previously to the commencement of the use of the tincture, which I have carried to the extent of sixty minims, three times in the twenty-four hours, I have seldom failed of procuring sleep, quiet, and the restoration of the patient to sound health and intellect. In one of these cases, which has since remained under my eye, the lady, a woman of eighty years of age, has continued for upwards of seven years in perfect mental health. In producing its effects, *Digitalis* cannot, with safety or advantage, be ventured on where the inflammatory diathesis presents itself ; and, therefore, in other diseases, as well as in mania, in which its narcotic influence may be required, the habit should be prepared by previous depletion. For obtaining this effect of foxglove, the tincture is assuredly the best of the officinal preparations : it should be made with the leaves, collected in dry, warm weather, and dried without artificial heat.

From these remarks, it is easy to ascertain the periods of disease in which foxglove is most likely to produce a beneficial effect. In phthisis, it is fitted rather for the advanced than the early stages of the disease ; and in ulceration of tubercles, provided the inflammatory pulse attendant on this stage of the disease have been previously subdued by the use of the lancet. M. Neuman of Berlin has found it an admirable remedy in chronic catarrh, when this depends on a state of crethrisism of the mucous membrane of the bronchi. He infuses ʒii of the dried leaves in fʒvi of boiling water, and

gives one spoonful of this infusion every hour, until nausea, or a sense of constriction of the throat, or irregularity of pulse, follow. The use of the medicine is then suspended for a week, and again renewed if the disease be not removed.

The utility of foxglove in affections of the heart has been questioned: but experience has confirmed its efficacy in hypertrophy of the left ventricle, with or without dilatation of its cavity: it diminishes the action of the diseased organ, and with this, the vertigo, pulsation in the head, singing in the ears, and other sympathetic affections of the encephalon attendant upon this state of the heart.

The effects of *Digitalis*, when overdosed, are those of a powerful narcotic poison. Sinking of the pulse, clammy perspirations, nausea, vomiting, and purging, are the most marked symptoms produced by it: sometimes salivation supervenes, and suppression of the urine. These symptoms arise from collapse, the effect of its stimulant influence: but foxglove, like mercury, accumulates in the system, when long administered, even in moderate doses; and continues to produce its constitutional effects after its use has been discontinued. The symptoms, in such a case, are nausea, vomiting, giddiness, want of sleep, sense of heat generally over the body, pulsation in the head, depression of spirits, sometimes diarrhoea, and, for the most part, profuse salivation: occasionally convulsions supervene, with a peculiar forgetfulness and delirium. Even when death does not follow a large accumulation of foxglove, the effect on the pulse does not disappear for many days. When foxglove excites nausea, or any symptoms of poisoning, they are to be counteracted by immediately suspending the use of the medicine, and administering cordials, as brandy and water, ammonia, opium, and the application of a blister to the pit of the stomach. Yellow cinchona bark, also, is an excellent antidote, as it forms an insoluble compound with the tincture and infusion of foxglove.

The powder of foxglove should not be employed unless it possess the beautiful green colour and the odour of the fresh plant; and to secure this state, it should be preserved in opaque bottles. But when the powder is employed, the dose at first should not exceed a grain; but this should be fre-

quently repeated, that is, once in eight hours, until the action be obvious, after which the dose should not be repeated oftener than once in twelve hours; then, in a day or two, once in twenty-four hours; and, ultimately, once in forty-eight hours. The infusion is incompatible with acetate of lead, infusion of *Cinchona cordifolia*, and the alkalies. In prescribing the tincture, also, it must be borne in recollection that both the bichloride of mercury and nitrate of silver are incompatible in prescriptions with it.

g. HYOSCIAMIA.—This is the active principle of Henbane, *Hyosciamus niger*, an indigenous annual, belonging to the natural order Solanæ*. It grows on waste ground, and flowers in July.

All the parts of this plant have an offensive, foetid odour, a clammy, slightly adhesive feel, and an appearance altogether indicative of its poisonous character. The taste of the plant is mucilaginous and slightly acrid, causing heat in the throat, nausea, a hot skin, an accelerated pulse, a tendency to sleep, headache, vertigo, and dilated pupils. The active principles of the plant are taken up both by water and alcohol; but decoction destroys them. The infusion is not affected by diluted acids: the alkalies change its colour to deep greenish yellow, owing to their action on the extractive. It is copiously precipitated by subacetate of lead, nitrate of silver, and sulphate of iron. Several chemists have analyzed Henbane. M. Peschier obtained from it, in addition to hyosciamia, a crystallizable acid resembling wax, and phosphate and carbonate of lime†.

This analysis throws no light whatever on the narcotic character of the plant. M. Brandes obtained from the seeds, by precipitating an infusion of them by means of the alkali, the peculiar alkaline principle now under consideration, *Hyosciamia*: it is procured in the form of oblong crystals, or prisms, which form neutral salts with nitric and sulphuric acids. The same alkaloid is found, also, in the root and the leaves, but in much less quantity than in the seeds. Experiments are still wanting to decide that this is the active principle of the plant.

* Woodville's Med. Bot. 3d edit. p. 204, pl. 73. London Dispensatory, art. *Hyosciamus*.
 † Biblioth. Univers. Sept. 1820.

M. Planché has procured an extract from the dried plant, by macerating one part of it in four parts of alcohol, for four days, filtering the tincture, and evaporating to dryness in a water bath, which has a beautiful green colour, retains all the virtues of the plant, and probably contains the real active principle.

As a narcotic, Henbane has been regarded analogous to opium in its effects. It operates directly on the nervous system, invigorating the pulse, producing an increased heat of the skin; and, after these effects have subsided, inducing sleep. It does not confine the bowels, neither does it affect the head so much as opium. In large doses, however, it acts as a virulent poison; causing in the first instance sickness, stupor, dimness of sight, hard pulse, delirium, coma, and dilatation of the pupils; afterwards, weakness, tremulous pulse, cold sweats, petechiæ, and frequently death. One effect of an overdose is singular: sometimes, the sense of sight seems for a few moments lost; again, objects appear much larger or much smaller than natural, more distinct or nearer, or they seem to move, dance, or fall, or they appear wrapt in a cloud, or of ever-varying colours. In some habits it excites a pustular eruption.

The ancients were acquainted with the narcotic powers of Henbane: Stoërck investigated its effects, and established its use as a narcotic in all painful diseases. It is frequently preferred to opium, as it rather tends to open than to confine the bowels: in ileus and colica pictonum I have found it very serviceable, in combination with colocynth and scammony. In mania it is much used, in combination with camphor; and certainly seems to soothe and procure sleep in these cases with less inconvenience than opium. But, under all circumstances, the narcotic powers of Henbane in mental affections are inferior to those of acetate of morphia. The extract of Henbane is given in doses of five grs. repeated three or four times a day; but, in my own practice, I have seen more good derived from eight or ten grains, combined with ten grains of camphor, and given at bed-time, than from the repetition of smaller doses. But Henbane merely procures temporary relief; and if more be expected from it in

mania, disappointment must follow. In melancholia, however, it is supposed to operate in a manner essentially different from that of any other narcotic, producing tranquil sleep without dreaming or spectral visions, removing pain where it exists, and exciting a gentle breathing perspiration, without quickening the pulse like opium. In cases accompanied with cramps, spasms, or convulsions, it may be combined with ipecacuanha or James's powder; or, if much languor be present, with serpentaria. It is regarded as peculiarly adapted for puerperal insanity. Mr. Brande recommends it for allaying the irritation caused by red gravel in the kidneys; and it is generally useful in every case of pain, particularly in neuralgia, affecting the facial nerves. Smoking the leaves in the manner of tobacco allays the pain of toothache and the difficulty of breathing in asthma. When applied to the surface, it also diminishes pain, dilates the pupil, and soothes greatly the irritation of scrophulous ulcers and cancerous sores. It therefore possesses anodyne as well as narcotic powers.

The tincture is the best form of exhibiting Henbane; but it is most frequently given in that of extract; much, however, depends on the goodness of the extract. The dose of the tincture is from m. xv to fʒi; that of the extract from gr. iii to gr. xvi; but it has been gradually carried to gr. lx. It should not be prescribed in combination with alkalies, nor with lime water, as these destroy its narcotic power.

Fatal cases of poisoning by Henbane and its preparations exhibit, on dissection, inflamed and gangrenous spots on the inner surface of the stomach. With a gorged state of the vessels of the brain, vinegar has been recommended as an antidote; but, from the action of the alkalies, I should feel disposed to place more confidence on them: the first step, however, is to evacuate the stomach; after which the habit may be roused by ammonia and cordials.

h. LUPULIA is a peculiar principle spontaneously formed in the strobules of the hop, the *Humulus Lupulus**, from

* Woodville's Med. Bot. 3rd edition, vol. v, p. 90, pl. 22. London Dispensatory, art. *Humulus*.

which it is named ; a well-known plant of the natural order Urticeæ.

The Lupulia, which is the active principle of the hop, is produced in the strobules or female flowers only ; it was first brought into notice by Dr. Ives, of New York ; and the hop was soon afterwards chemically examined by M. Payen and Chevalier, two French chemists. The result of their experiments led them to conclude that it contains a volatile oil, carbonic acid, subacetate of ammonia, traces of osmazome, gum, malic acid, malate of lime, a bitter principle, a large proportion of resin, silica, traces of carbonate, muriate and sulphate of potassa, carbonate and phosphate of lime, oxide of iron, and some sulphur. As might reasonably be supposed, no light was thrown upon the medicinal character of Lupulia by the display of this long list of constituents of the hop. The Lupulia is easily extracted from the hop by merely sifting the ripe strobules : it is generally mixed with much siliceous matter, which can, however, be easily separated by washing and decantation. The examination of this principle, chemically, has ascertained that its constituents are tannin, extractive, bitter principle, wax, resin, lignin, and a volatile oil ; and from the result of reagents on the infusion of hops, it is probable that hops contain nearly the same constituents. It is rendered turbid by all the mineral acids ; its colour is greatly deepened by the alkalies, but no precipitates are thrown down by them : the salts of lead, iron, mercury, and zinc, are decomposed, and form precipitates in the infusion of hop.

The expectations that were some years since raised respecting the narcotic properties of hop and Lupulia, have been completely disappointed. The hop itself, as a remedy, can only be regarded as a pleasant bitter ; the best mode of exhibiting which is in well-brewed beer : the Lupulia is a weak narcotic.

Lupulia may be administered in the form of powder, in doses between ten grains and a scruple, or in that of tincture or of extract. From forty to sixty minims of the tincture are said to act kindly as a soporific.

CAMPHOR, *Camphora*. L. E. D.—Camphor possesses both

stimulant and sedative properties, which closely resemble those of opium, the stimulant producing a degree of collapse in the direct ratio of the excitement. Besides operating as a narcotic, it also displays anodyne effects, producing sleep* and relieving pain. This occurs even when dangerous doses have been taken. Thus, in a case published by Professor Wendt, of Breslau†, a man of seventy-three took four ounces of camphorated spirit which were intended for external application: burning heat of skin, a hard, full, and quick pulse, the eyes sparkling, the face red and swelled, with great weight of head, anxiety, agitation, a sensation of burning in the stomach, intense cephalalgia, vertigo, and disordered vision, followed. The quantity thus taken was one hundred and sixty grains. The treatment was the repeated administration, every half hour, of a spoonful of vinegar and gruel. In the course of the night the sufferer became more calm, the headache, cephalalgia, and anxiety diminished, a copious sweat broke out, and this was succeeded by three hours of tranquil sleep; the pulse nevertheless continued quick and full; the urine was obstructed, and for some time was passed with difficulty. Under the use of an infusion of foxglove and acetate of potassa his health was gradually restored. In some instances a cutaneous eruption follows its use; but this indicates some peculiar idiosyncrasy. It causes no irritation of the mucous membrane of the intestinal canal; excites neither pain nor borborygmi; but occasionally causes constipation. Such are its narcotic effects when it is taken into the stomach of a healthy man; but disease has a powerful influence in modifying its action.

Many experiments have been made to ascertain the real influence of Camphor, as a narcotic, on the animal œconomy; but with little satisfaction. In the same manner as opium, when it is intended that it should exert a stimulant effect, it should be given in small doses frequently repeated; on the contrary, it should be given in large doses, and at consider-

* Haller states, that persons employed to empty bags of Camphor become first highly exhilarated, and then fall asleep, even when they are conversing.

† Rust's Magazine, tom. xxv, 1er cap.

able intervals, when we require its sedative influence to be exerted on the system.

Camphor has been prescribed in every kind of fever: in intermittents, during the paroxysm, to allay irritation and procure sleep. Cullen affirms that, in nervous fevers attended with delirium and much watchfulness, he frequently employed it with advantage; but, in this respect, it is greatly inferior to opium. It, however, forms an agreeable and useful adjunct to opium. Galen prescribed it in hectic: Poterius, who was a disciple of Paracelsus, employed it in the form of vapour, in combination with assafœtida, in phthisis: Lieutaud, Burserius, and Dr. Percival, were also advocates for its administration in consumption: and Dr. Rollo recommends it, in conjunction with hepatized ammonia and conium, in the incipient stage of phthisis. What has been detailed of its mode of operating will enable the student to judge of the propriety of this practice. In the phlegmasiæ, Camphor has been prescribed often on mistaken principles, under a conviction that its primary action is sedative. As an external application, it has been frequently employed as a sedative in ophthalmia; but, in the active state of this disease, it is injurious, and is best suited for that passive state which is the result of the scrophulous diathesis, or in old chronic inflammation of the conjunctiva.

In all spasmodic diseases, Camphor has been employed almost generally; and it may act either as a stimulant or a sedative according to the manner in which it is administered; but, under either point of view, its effects are, in every respect, inferior to those of opium and many other articles of this division of narcotics. It is a powerful agent for soothing cramps and colic when externally applied; but, in this instance, it may operate as a counterirritant. In mania, its powers have been greatly overrated: yet it is a curious fact that the pulse of furious maniacs falls as low as fifty when they are under the influence of Camphor; and a sedative effect follows; but without any diminution of their sufferings. "By its duration," says Dr. Hallaran, one of the most sensible writers on maniacal complaints, "the countenance eventually assumes a livid aspect; the extremities also

become cold and insensible, and equally livid with the face. The arterial blood seems as if concentrated in the vessels immediately issuing from the heart; the action of the lungs is impeded; and congestion, determining to the head, is often the inevitable consequence. The power of reaction of the heart, under such difficulties, is, in fact, suspended; and the torpor of the system, previously existing, is thus greatly aggravated." Dr. Hallaran regards it as a very uncertain medicine in the treatment of mania. Nevertheless, Dr. Perfect relied on it in insanity, and illustrated his opinion by details of a hundred and three cases in which it produced most essential benefit. He gave it in doses of two scruples night and morning.

In nymphomania, a disease depending on a morbid sensibility of the uterus and its appendages, after copious bleeding and other evacuations, Camphor has been found highly beneficial; and it is also an admirable adjunct to opium in that variety of insanity which frequently follows a continued course of intoxication from wine and spirituous potations.

Camphor is exhibited in various forms as a narcotic. The quantity requires to be considerable to produce a soothing effect; and therefore it should be given either in substance, in the form of pill, or precipitated from alcohol and diffused in almond emulsion or mucilage and water, or it may be dissolved in any water impregnated with carbonic acid, as with that acid it forms a complete solution.

Some of the Continental physicians advise Camphor always to be administered in the state of vapour when its anodyne powers are required. This is effected by placing the patient on a chair with an open cane bottom, beneath which a chafer, covered with a plate of iron, is placed; and surrounding the whole with a blanket, pinned round the neck of the patient. A dessert-spoonful of Camphor in powder is then thrown upon the hot iron plate, which volatilizes it, and involves the body in an atmosphere of the medicine. The patient perspires freely; and, in three-quarters of an hour afterwards, is to be rolled in the blanket and carried to bed. The sweating is then to be kept up by tepid fluids. In chronic rheumatism, the disease for the relief of which this Camphor

bath is chiefly used, the fumigation may be repeated three or four times a day ; and it ought to be continued for some time after the pains have disappeared*.

The next substances in the Table of Narcotics owe their efficacy to an unknown principle variously combined. The circumstance that many substances owe their narcotic influence to an alkaline principle has induced chemists to look for alkaloids in every medicine which displays narcotic properties. There are many reasons, however, for thinking that, in various instances, the alkaloid is the production of the operation employed to obtain it, and consequently that the influence of the vegetable, in its entire state, must depend on something else than the alkaloid. No alkaline principle has been found in the following Narcotics.

a. RHODODENDRON CHRYSANTHUM, Yellow Rhododendron, E. is an article of the Materia Medica only of the Edinburgh Pharmacopœia. It is a Siberian plant belonging to the natural order Erinaceæ†. Either from the effects of drying and transport, or from the nature of the constitutions of the patients in this country, the effects of this narcotic have been very different, when used in Britain, from those experienced in Siberia. There its effects as a narcotic are so well known, that its vulgar name implies intoxicating tea. Its chief use as a medicine is in gout and rheumatism. The Siberians infuse two drachms of the leaves in twelve fluid ounces of water, for a night, in a warm place. This dose is taken in the morning, on an empty stomach : it soon nauseates ; and, while this continues, no food is allowed to be taken. After some time, it generally produces a copious, black, foetid motion ; and the patient rises free from pain if the disease be rheumatism ; if it be gout, the medicine requires to be repeated for three successive days before the paroxysm yields.

* The most recent and the best account of Camphor and its virtues is contained in the *Traité de Camphor* of Graffenaur, published at Strasburg in 1823.

† Woodville's *Med. Bot.* third ed. p. 299, pl. 105. London Dispensatory, art. *Rhododendron*.

Could such effects be obtained from it in this country, it certainly would be a most valuable addition to our *Materia Medica*.

b. LACTUCARIUM. L. E. D.—The genus *Lactuca* yields a white proper juice, which has much of the sensible properties of opium, when inspissated. This juice, termed *Lactucarium*, was first introduced to the notice of the profession by Dr. Coxe, of Philadelphia. An expressed inspissated juice of the lettuce, termed *Thrydacé*, from *thridax*, the Greek for lettuce, is used by the Continental physicians.

The *Lactucarium* is procured from both the *L. virosa* and the *L. sativa**. M. Schutz procured from one plant of the *virosa* fifty-six grains of dry *Lactucarium*, and seventeen grains only from a plant of the same weight of the garden lettuce. The best time for procuring *Lactucarium* is when the plant is in flower; for at this time the vessels are so turgid with proper juice, that merely touching the flowering pedicels causes it to exude. This effect is justly ascribed to the greatly increased irritability of the plant at this time. When the vessel is excited, the part contracts so suddenly as to burst the coat of the next portion into which the superabundant juice is thrown.

Various means are employed for collecting this proper juice: the simplest is to make transverse incisions in the stems of the plants, to scrape off the exuded juice with a thin silver spatula, and collect it in a glass or porcelain vessel, in which it should be left to thicken in the ordinary temperature of the air, or exposed to a heat not exceeding 120° Faht. The *thrydacé* of the French differs in being the expressed juice of the lettuce, and consequently in containing a variety of products besides the proper juice of the plants.

Lactucarium has the colour, and in some degree the odour and taste, of opium. Water dissolves 50 parts in 100 of it: this consists chiefly of mucus and the narcotic principle of the preparation, whatever this may be; the other constituents, according to an analysis of Pfaff, are 8.10 parts of wax, 7.4 of resin, and 22 of caoutchouc. Caventou, Dublane, jun.

* Woodville's *Med. Bot.* third ed. p 76, pl. 31. London Dispensatory, art. *Lactuca*.

and Ganzel, examined it expressly with the view of obtaining morphia from it; but could procure none. The narcotic principle of *Lactucarium* is therefore still unknown.

The narcotic properties of lettuce were very early known: Galen, who in the decline of his life suffered from wakefulness, found much comfort in eating a lettuce in the evening; and every one who has indulged the same luxury must have experienced the soporific effects of this plant. Celsus also mentions its soporific powers: "*Somno vero aptum est lactuca, maximeque æstiva, cujus cauliculus jam lacte repletus est**." Dr. Coxe made a set of experiments to ascertain how far *Lactucarium* resembled opium in its medicinal effects: he found that they were precisely the same as opium: but, although it may be used as a substitute for opium by persons who, from idiosyncrasy, cannot take opium without suffering, yet its properties are not exactly the same: his results were confirmed by the subsequent experiments of Dr. Duncan, sen. The dose of *Lactucarium*, in the solid form, is from one grain to twenty grains.

c. ARNICA MONTANA. Leopard's Bane. E. D.—The flowers of this plant also possess narcotic powers depending on some unknown principle†. The action of the flowers of *Arnica* is at first powerfully stimulant, irritating the whole of the alimentary canal when the dose exceeds ten grains: it excites the brain, accelerates the pulse, and increases the function of the skin. These effects may result from one dose, and usually continue longer than twenty-four hours: they are followed by sleep. The flowers of *Arnica* are seldom or never employed in this country.

d. RHUS TOXICODENDRON. Poison Oak. L. E. D.—This shrub belongs to the natural order *Anacardiaceæ*. It is a native of North America‡. The proper juice of the plant is white; but it becomes black when exposed to the action of the air, and on this account it is used as a varnish in Japan. A volatile principle is exhaled from the living plant which acts powerfully upon the skin, inflaming and blistering it. Van Mons, who examined this exhalation, states that it is given

* *De Medicina*, lib. ii, § xxxii. † Woodville's *Med. Bot.* third ed. p. 41, pl. 17. ‡ *Ibid* vol. v, p. 67. *London Dispensatory*, art. *Rhus*.

out chiefly during the night, and is combined with carburretted hydrogen gas. This opinion, however, is of little weight, and merely conjectural.

The leaves, the parts of the plant medicinally employed, yield their virtues both to water and alcohol. Besides their unknown narcotic principle, they contain also a large proportion of tannin, mucus, and extractive; on which account the infusion yields precipitates with sulphate of iron. Acids discolour it; the alkalies greatly deepen the colour.

As a narcotic, the leaves of the *Toxicodendron* have been much praised by Dr. Alderson, of Hull, in paralysis; and they have been used in hepatic affections. They cause a sense of heat and pricking in the affected limb—symptoms that anticipate the relief or the cure of the disease. These facts, which were first promulgated by Dr. Alderson, have not been confirmed by other practitioners in this country; but Dr. Gevesins, in some experiments with this plant in paralytic diseases, found that four out of five of the cases treated with *Toxicodendron* were cured. He gave it in doses of a quarter of a grain twice a day. The dose may be gradually increased to four grains; but the plant is rarely employed.

INORGANIC PRODUCTS WHICH OPERATE AS DIRECT NARCOTICS.

b. ETHER.

* *Free.*

a. *ÆTHER SULPHURICUS.* *Sulphuric Ether.* L. E. D.—The chemical properties and composition of this fluid have been already described (page 290). Like all other diffusible excitants, Ether displays narcotic effects; but it is seldom administered with this view except in combination with more decided narcotics than itself.

* * *Combined.*

b. *SPIRITUS ÆTHERIS SULPHURICI.* *Spirit of Sulphuric Ether.* L. Syn. *Æther Sulphuricus cum alcohole.* E. *Liquor Æthereus Sulphuricus.* D. In whatever manner prepared, this is a simple mixture of Ether and alcohol. Its narcotic

powers are precisely the same as those of Ether. The addition of the aromatics contained in the *Aromatic Spirit of Ether* of the London Pharmacopœia merely renders this preparation more grateful.

c. SPIRITUS ÆTHERIS SULPHURICI COMPOSITUS. *Compound Spirit of Sulphuric Ether*. L. Syn. *Hoffman's Anodyne*. In preparing Sulphuric Ether, by continuing the process after white fumes are disengaged, sulphurous acid is evolved, and a yellowish fluid, usually termed *etherial oil*, passes into the receiver: two fluid drachms of this oil and a pint of spirit of Sulphuric Ether form the preparation now under review. The etherial oil has a fragrant odour and a bitter, pungent taste: its specific gravity is 1060. It is to this oil that this preparation is supposed to owe its anodyne and soporific powers. In doses of thirty minims, in a fluid ounce and a half of camphor mixture, this spirit of Ether allays pain and operates as a gentle soporific. It is an excellent addition to opium; and is considerably less exciting than simple Ether.

B. INDIRECT NARCOTICS.

m. TINCTURES OF NARCOTICS.—All the narcotic substances which have been described may be administered in solution in alcohol, more or less diluted, or in the form of tincture. In many instances, the quantity of a narcotic tincture is too small to allow any part of its influence to be attributed to the spirituous vehicle; but, in some instances, this is not the case; and the custom of prescribing large doses of tinctures in hysterical and hypochondriacal attacks has too frequently produced a propensity for drinking in females—a pernicious habit which is rarely overcome in the softer sex. Independent of this objection to the use of alcoholic tinctures, a question may arise, namely, does the alcohol augment the power of the narcotic dissolved in it? There can be no doubt that the alcohol employed aids the introduction of the narcotic principle into the blood, and enables it to be more directly applied to the nervous centres, and consequently increases its powers. Nor is this opinion at variance with the doctrine which I maintain of narcotics acting through the

nerves; for the impression must, in either case, be communicated to the sensorium before it can be extended to the whole system. Where the narcotic possesses in itself decidedly stimulant as well as sedative principles, the addition of diluted alcohol, in the small proportion contained in the dose of an active medicine, cannot certainly interfere with its operation; but, when the sedative principle predominates in the narcotic agent—as, for example, in henbane—and when we wish for the sedative influence chiefly to be exerted, then undoubtedly the extract is to be preferred to the tincture. On the other hand, where it is necessary to stimulate, and at the same time to produce an anodyne effect, where sleep is not so much the object to be attained as the abatement of pain, under such circumstances, tincture of opium and other narcotic tinctures are well fitted to fulfil the indication. Upon the whole, however, few medicines require more judgment for their proper administration than the narcotic tinctures.

n. VERATRIA.—This is an alkaline principle which was discovered by MM. Pelletier and Caventou* in the seeds of *Veratrum Sabadilla*, the roots of *Veratrum album*, and in the *Colchicum autumnale*, from all of which it is procured by a process which it is unnecessary to detail, as Veratria is not medicinally employed in its uncombined state. It is a white, pulverulent, very acrid, inodorous substance, displaying an alkaline reaction, scarcely soluble in cold water, and requiring even a thousand parts of boiling water for its solution. It is very soluble in alcohol, in ether, and in all the vegetable acids, saturating them and forming neutral and uncrystallizable salts. With sulphuric acid it affords a bisulphate which can be imperfectly crystallized. Nitric acid decomposes it and produces a yellow detonating substance allied to the bitter principle of Welther. Iodine changes its white hue to a tarnished yellow; brome to a pale yellow. According to Pelletier and Dumas, it consists of Carbon 66.75, + Oxygen 19.67, + Hydrogen 8.54, + Nitrogen 5.04, in 100 parts. Veratria fuzes at a temperature of 122° Faht., and, on cooling, assumes the appearance of pale amber. A higher tem-

* Ann. de Chimie et Phys. t. xiv, p. 69.

perature decomposes it, producing the same results as on the other alkaloids.

In minute doses, *Veratria* stimulates powerfully the mucous membrane in whatever manner it is applied to it: thus, if taken into the mouth, it excites salivation; if snuffed up the nostrils, the most violent sneezing; if taken into the stomach, it stimulates both the orifices of the gall-ducts and the intestinal nerves, causing the most abundant discharge of bilious, watery stools; and, if the dose exceed a quarter of a grain, violent vomiting is induced. As I have already stated, *Veratria* is not medicinally employed in its uncombined state; but, in its natural combination, as contained in the *Colchicum autumnale*, it is in daily use as an indirect narcotic.

*Colchicum autumnale**, Meadow Saffron, is a bulbiferous plant, found in moist meadows, in many parts throughout southern and temperate Europe, and very abundantly in England: it belongs to the natural order Colchicaceæ. The *Veratria* is contained, in combination with an unknown acid, in the bulbs, the flowers, and the seeds of the Meadow Saffron. Pelletier and Caventou call this acid the gallic; but this is doubtful. The *bulb* is at its perfection, in this country, in June and July; but locality and climate modify this greatly. Thus, Maranta and Haller state that it is sweet or tasteless and inert in the autumn, and may then be eaten: Krapf says that it is eaten in the autumn in Carniola and Istria. The perfect bulb, when cut transversely, exudes a white juice, which has a sweetish, biting, acrid taste, and exhales an odour which irritates the mucous membrane of the nostrils. The juice is often so acrid that Storck asserts that, on rubbing some of it on his tongue, it swelled, became rigid, and continued as if benumbed for six hours. It is very poisonous to dogs; thence the Dutch name *Hundes hoden*, and the French name *Tue-chien*. The Swiss peasants tie the bulbs round the necks of their children, as amulets, to preserve them from all diseases. When the bulb is good, it is heavy, firm, and, when cut transversely, is nearly an entire oval; when it is bad and shrunk, the slices are panduriform.

* Woodville's Med. Bot. third ed. p. 759, pl. 258. London Dispensatory, art. *Colchicum*.

According to the analysis of Pelletier and Caventou, the bulb contains—1. a fatty mater, formed of stearine, elaine, and a peculiar volatile acid ; 2. Veratria combined with gallic acid ; 3. a yellow colouring matter ; 4 gum ; 5. starch ; and 6. inulin in abundance, besides ligneous matter.

If the flowers be macerated in wine, the salt of veratria which they contain is taken up, and a preparation equal in efficacy to the wine of the bulb is produced. In a similar manner the seeds also yield the veratria to wine, and a very active preparation is the result. The veratria resides in the testa of the seeds ; the seeds, therefore, do not require to be bruised when put into the wine.

Notwithstanding what is recorded regarding the impunity with which the bulbs of *Colchicum autumnale* have been occasionally eaten*, there is no doubt that the whole plant is a very active poison. Garidel, in his work “*Les Plantes d’Aix,*” relates that a man having eaten the flowers of *Colchicum*, as a remedy against ague, was affected with violent pains of the bowels and other pains for several days. John Agricola Ammonius has recorded a case of two boys who were killed by eating the flowers whilst playing with them in a field ; and several cases are recorded in which children have fallen victims to the poisonous properties of the seeds, which are relished by children. I have seen two cases of poisoning from an overdose of the wine of the bulb ; and, in the 14th vol. of the *Edinburgh Journal*, a case of this kind is detailed : a man took fʒiiss of the tincture by mistake, and died in forty-eight hours, after suffering much from vomiting, acute pain of the stomach, colic, purging, and delirium. Dr. Schobel, in a thesis published at Tubinjin, in 1817, has accumulated much authentic information on this subject. He states that *Colchicum* is poisonous to animals of all classes—horses, dogs, cats, rabbits, jackdaws, starlings, frogs, snails,

* All the species of *Colchicum* yield veratria ; but, from a set of comparative experiments on four different species, I found that the *Autumnale* yields the largest proportion of veratria, and consequently is the most active in a medicinal point of view ; and the *Byzantium* the smallest quantity ; and as it contains one fourth only of the proportion in the *Autumnale*, I am inclined to think the bulbs of *Colchicum*, which have been eaten with impunity, belong to the species *Byzantium* and not to the *Autumnale*.

and even flies ; and that it acts in whatever way it is introduced into the system, whether taken into the stomach, or injected into the windpipe, or applied to an external wound. Instinct leads quadrupeds to avoid the foliage in the fields ; but when it is eaten mixed with other food, it powerfully affects them, causing purging of blood, inflammation, and sometimes gangrene of the intestines.

In the cases of poisoning with the solution of the bulb in wine, which came under my notice, the symptoms were great anxiety, violent agitation, tremors of the extremities, vomiting, and bloody diarrhœa, cold clammy sweats, and such prostration of strength as soon terminated fatally. In some of the recorded cases, it appears to have acted locally on the gullet and stomach, producing a sensation of burning in those parts ; with giddiness, blindness, and dilated pupils. Post-mortem examinations display appearances of violent inflammation having existed in the gullet, stomach, and colon ; and in some instances through the whole mucous membrane of the intestinal canal. On every consideration of the subject, it appears that veratria, as it exists in Colchicum, exerts a double action on the living system—a local stimulant influence and a narcotic sedative effect ; which is probably the result of the prior stimulant action.

Some idiosyncracies resist the poisonous effects of Colchicum in an extraordinary degree.

Notwithstanding these violent effects of Colchicum, it is a very efficacious and valuable medicine. It was used by the ancients under the name of *Hermodactyllus* ; by which name it was sold in the druggists' shops in this country in the time of Turner the herbalist. Alexander Trallianus, a Greek physician, was the first who recommended it in gout. Paulus Æginetus extols it as a purgative in pains of the joints ; and it was after this period very generally employed, until some circumstances again threw it out of use, when it was only occasionally resorted to as a diuretic. The surprising effects of an empirical French remedy, the *eau medicinale*, again brought Colchicum into notice, and few medicines are now so generally employed.

Colchicum operates chiefly on the duodenum ; stimulating

powerfully the excretory ducts of the liver and pancreas, producing copious bilious stools, diminishing febrile action and consequently allaying pain. It is chiefly owing to its operation on the bowels that the beneficial effects which follow its use in gout and rheumatism result: and I have rarely seen any benefit derived from it until its operation on the bowels is obvious.

Colchicum is generally supposed to exert some specific influence on gout and rheumatism. This is a doctrine which I cannot understand; but I can fully comprehend how gout and rheumatism are relieved: by emptying the gall ducts and carrying a large quantity of vitiated secretions out of the habit. Its local influence on mucous surfaces generally, when it is applied to them, as exemplified in the errhine effects of veratria, throws considerable light upon the rationale of its action; as, by causing a determination of blood to so great an extent of surface as the mucous lining of the intestines, the inflammatory action going on in the joints will necessarily be lessened, on the principle of counterirritation; at least, it is only in this manner that I can explain its influence. Its primary action is purgative; its secondary indirectly narcotic.

Much of the efficacy of Colchicum depends on the mode of preserving the parts of the plant employed: if the bulb be the part, it should be sliced very thin, and the slices dried in an obscure place at the ordinary temperature of the atmosphere. During the drying, each slice should be separated from the others, and placed on clean, colourless, bibulous paper, and turned twice: as soon as the slices are dry, they should be put into a well-stopped bottle. The *flowers* must be gathered when they are fully blown, in dry weather, and gently pressed between bibulous paper: when dry, they may be reduced to powder and preserved in a well-stopped bottle. The *seeds* should be gathered when fully ripe: they undergo no change for a considerable time, even when exposed to the atmosphere, and, therefore, little care is required to preserve them in a state fit for use.

With regard to the preparations of Colchicum, three menstrua have been employed, alcohol, wine, and vinegar. Sir C. Scudamore prefers the tincture, and states that proof spirit

is the best solvent of the active principle. The chief advantage of this preparation is, that the starch, gum, and inulin are not taken up by the alcohol ; and, therefore, the tincture may be regarded as an alcoholic solution of the salt of veratria*. With regard to its superiority over the other preparations, experience only can determine whether a gallate or any other salt—a tartrate, for example, or an acetate of veratria—be the best medicine. As far as my own experience authorizes me to decide, the wine is the preferable medicine.

The wine of *Colchicum* is ordered to be prepared with the recent bulb, by the London College, without wine ! but even if wine were the vehicle, the fresh bulb is highly objectionable, from circumstances which we cannot controul ; such as soil, climate, season, and other accidental occurrences ; the quantity of fluid contained in the bulb must vary and necessarily alter the strength of the preparation made with the fresh plant. If the bulb be taken up at a proper time and carefully dried, the dry sliced bulb is to be preferred for making the wine. Sherry wine contains free tartaric and malic acids ; but it has not yet been determined whether any of the veratria contained in the wine of *Colchicum* be a tartrate or an acetate. The wine formed with the seeds is milder in its operation than that made with the bulb ; but I cannot explain on what this depends. The wine of the seeds is prepared by digesting ʒii of the unbruised seed in two pints of sherry, for eight days. The reason why the seeds are ordered to remain entire is on account of the veratria being contained in the testa or husk ; for if the seeds were much bruised, the preparation would be less pure and more liable to spoil, from the admixture of the feculaceous matter of the cotyledons. The oxymel and vinegar shall be noticed under the head of Diuretics.

The powder of *Colchicum* may be employed instead of any of the preparations which I have mentioned ; and in the diseases of infancy and childhood it is the best form of giving the remedy. The dose of the powder is from gr. iii to gr. ix ; that of the tincture and the wine from m. xv to ʒi ; repeated every eight hours. Neither acetate nor subacetate of lead

* This salt, as I have already stated, is asserted to be a gallate ; but this is questionable.

can be administered with the wine, insoluble compounds being thrown down, independent of the veratria, and thus the purpose for which the salts of lead are administered is defeated. In gouty affections, the tincture and wine are usually combined with magnesia; and this has been supposed to be necessary on account of the acescent state of the stomach in gout, and the necessity of correcting this, independent of any influence it has on the Colchicum: but I am inclined to think that it acts an important part in the operation of the medicine, by preventing the decomposition of the salt of veratria, whatever that may be, and the formation of the acetate of veratria, which, instead of operating as a sedative, would act solely on the kidneys. It is true, that in the decline of every gouty paroxysm, a large excretion of uric acid takes place as a critical discharge; and, it must be admitted, that one of the effects of the action of Colchicum on the kidneys is to augment the quantity of this, either in a free state or in combination with ammonia. Thus, Chelius found that, on the fourth day after taking Colchicum, the quantity of uric acid excreted was 0.069 parts: after four days using it, the quantity was 0.076 per cent.: eight days, 0.091: twelve days, 0.112: so that the excretion was nearly doubled in twelve days. Upon the whole, whatever may be the value of Colchicum in gout and painful diseases, it evidently exerts only a secondary narcotic influence: the unloading the biliary system, by diminishing the morbid excitement, effects the same result in painful inflammatory diseases, as if it were a direct narcotic, with this superior advantage, that the benefit is more permanent.

C. MENTAL NARCOTICS.

Our passions, medically considered, are phenomena which produce decided effects on our corporeal frame—sometimes causing diseases, sometimes curing them. Those persons who are endowed with great nervous sensibility are for the most part powerfully effected by mental pleasures and pains: and therefore, when the higher orders of society, and men of intellectual acquirements, are affected by mental diseases, it is sometimes necessary to employ Mental Narcotics, when material substances fail in procuring repose. Let us examine briefly the manner in which these operate.

Mental impressions act upon the nervous system in general, and rouse or depress according to circumstances. If we select *Music* as illustrative of the manner in which Mental Narcotics operate, we find that the first effect of its impression is that of an excitant; it rouses the attention: but the repetition of the impression at length exhausts, in the same manner as follows the repetition of any series of stimulant impressions of the same kind, and sleep is induced. It may be supposed that in this case Music, operating upon the auditory nerves, can scarcely be regarded as a Mental Narcotic: but the simple sounds, unless they are so combined as to produce agreeable emotions, sufficiently powerful to withdraw the attention of the sufferer from the train of morbid associations which characterize his disease, are followed by no anodyne nor soporific effect. In this respect, therefore, although the impression be made first upon a corporeal organ, yet the remedy may be regarded as mental. It must, however, be recollected, that it is not the succession of sounds that causes this effect, but the repetition of the same sounds, the same combination of sounds or impressions. Were they much varied, the opposite effect would result; for it is a well-known law of the system, that the variation of a stimulant impression renews the excitement in such a manner as to be much less likely to be followed by collapse than when there is a repetition of the same impression. To illustrate this influence, I need only refer to the effect of listening to the gurgle of the mimic cataract of some mountain rill; or to that of any small waterfall, even under less romantic circumstances: how decidedly is felt the influence of the monotony of the sound gradually disposing to sleep. This soporific effect of the repetition or monotony of sound is beautifully alluded to by Mackenzie in his novel of the Man of Feeling. When his hero, Mr. Harley, arrives in London, he finds that the noise and varied excitements of the metropolis increase his nervous state of habit and prevent him from sleeping. Ordinary narcotics produce no effect upon him; and he must have continued to suffer from watchfulness, if he had not happily touched his shoe buckle, which lay upon the table, when the vibration produced a monotonous sound so closely resembling the voice of his good aunt, who nightly read him

asleep in the country, that from that time he regularly applied to the same narcotic, and always slept soundly. It is a common observation that a dull sermon is a good soporific : but I am of opinion that it is less the dullness of the matter of the sermon, than the manner in which it is read, which produces this effect. Now, Music operates in the first instance on the same principle : in the second, by the associations which it engenders. If it be slow and plaintive, the impressions are longer continued, less varied, and therefore more soporific ; and along with this we must also take into account the sedative effect of all depressing passions ; and melancholy, which is the effect of plaintive music, is one of these. This power of music is much increased, also, by the period of the day and the situation in which the listeners are placed.

“ How sweet the moonlight sleeps upon this bank !
Here will we sit, and let the sounds of musick
Creep in our ears ; soft stillness and the night
Become the touches of sweet harmony.”

In some peculiar cases of insanity, therefore, where music is advisable as a remedy to produce sleep, the evening is the best period for trying its effects ; and this period is chosen, also, for the further reason, that, when the sleep is induced, there is much less likelihood of its being disturbed than if it occurred in the day. In the application of this Narcotic, the chief difficulty arises in determining the character of the individuals, and the nature of the attack, in which it is likely to prove serviceable. The kind of music, also, best fitted for the occasion requires consideration. In general, it must be such as will withdraw the mind of the patient, if it at all arrest his attention, from old associations, and give his ideas an entirely new direction : in others, it will prove most salutary if it recall his mind to former habits, and spread before the imagination the scene of past hours, in which domestic happiness reigned undisturbed in the bosom of the sufferer. Under such circumstances, the cloud which has settled upon the mind may be happily dispersed, and Reason restored to her seat.

The effects of gentle and slow friction in producing a narcotic result are referrible to the same principle, the repetition

of impression on the nervous system. I have witnessed the powerful influence of gentle friction, in producing sleep, in many instances. In cases of pain, in particular, gentle friction produces a considerably soothing effect, by transferring the attention from the seat of pain to the mild and agreeable impression of the friction: and this is still more powerful, if to this impression be joined another, which, although operating on a distinct sense, yet, by the combination, becomes more soporific: thus, the patting of an infant on the back, whilst, at the same time, the nurse hums a monotonous tune, is almost sure to procure sleep. Were this the proper place, I could adduce many instances of the excellent effect of such narcotics.

The remarks upon the remedial employment of opium, and the other narcotic substances which have been under review, render any further discussion upon the general employment of this class of medicines, as therapeutical agents, superfluous.

SECTION VI.

ANTISPASMODICS.—MEDICAMENTA ANTISPASMODICA.

Antispasmodics are usually defined “substances that allay irregular muscular contraction.”

Whatever be the nature of the ultimate fibrils of muscles, whatever the manner in which muscular contraction takes place, it may be affirmed that it is solely attributable to the nervous system. The extremities of the nerves are so intimately connected with the muscular fibrils, that we have no reason for supposing the existence of the one independent of the other; and it is now fully acknowledged, that the absence of sensation is no proof that a muscular or contractile organ is not amply supplied with nerves. In stating this opinion, however, I must also declare that I do not hesitate to accord with the assertion of Provost and Dumas, that the nervous fibrils do not amalgamate so as to be lost in the muscular fibres, but return or anastomose with other nerves. These physi-

ologists are, in my opinion, so far correct; but we acquire little light from such minute investigations. What does anatomy teach us respecting muscles? That they are fasciculi of many filaments of muscular fibres, attached to parts intended to be moved: that these fibres are united to one another by the medium of cellular matter: and that they are supplied with arteries, veins, lymphatics, and nerves, which ramify through this tissue. Whatever may be the impulse given to the muscle, when it acts in order to move a part, it contracts or shortens its length between the extremities. The physiologists whom I have mentioned, Provost and Dumas, assert that muscular contraction is an electrical phenomenon; and they suppose that the approximation of the nervous filaments to one another, drawing the muscular fibres into angles, is the cause of muscular contraction. How very imperfect is this explanation! how very imperfect all that has yet been attempted! The rationale is incompatible with, and far beyond, the highest powers in physics; leaving at an immeasurable distance those of chemistry; and permitting us simply to acknowledge, that it is a *vital phenomenon* of which we know nothing.

Whatever may be the immediate cause of the contraction of a muscle, therefore, we can only affirm that it is an action attributable to the nervous system: that the nerves of motion are those engaged in it, whether the stimulus or exciting power be mental or corporeal. The motion which is induced is transitory, and always followed by a state of rest. It is this alternation of action and quietude, under due regulation, that constitutes the distinction between *regular* and *inordinate* muscular motion. If, after a muscle or any set of muscles have contracted, this state remains when the exciting cause has ceased to operate, it constitutes what is termed spasm; or, if motions occur in the voluntary muscles, independent of the will, this constitutes convulsions. Now, these states are frequently the result of irritation communicated to the origin of the nerves, or to their sentient extremities; and they cease as soon as the exciting cause ceases to exist. In some instances, also, inordinate action in the muscles is the consequence of too great susceptibility of impression, owing to a

want of tone. Whatever, therefore, removes the irritating substance which has produced the spasmodic contraction, whatever resolves this state, is an Antispasmodic.

If narcotics allay irritability, sooth pain, and diminish the susceptibility of impression, it may be reasonably demanded in what do they differ from Antispasmodics? The chief circumstance in which Antispasmodics differ from Narcotics is, that the former is not followed by the insensibility to impressions and the collapse which invariably follows the use of Narcotics. Such effects cannot be induced by any dose of an antispasmodic; yet are they more powerful than narcotics in repressing inordinate muscular motion. In explaining, therefore, the difference between a Narcotic and an Antispasmodic, I may hazard the opinion, that it is probable that the impression on the extreme nerves made by a Narcotic is confined to those of sensation, and must be communicated to the brain before the effect is produced; whereas that of the antispasmodic is confined to the nerves of motion, and produces an immediate and more permanent result by some change produced in the state of the motor nerves, independent of any communication with the sensorium. If this opinion be correct, Antispasmodics, in the strict sense of the word, stand in the same relative position to narcotics as astringents to tonics. But, whatever may be their mode of action, the distinct nature of an Antispasmodic, acting simply as such, is very obvious; and Antispasmodics may be regarded as holding an intermediate place between *Narcotics* and *Tonics*; less diffusible, but more durable in their effects than the former; more immediate, but less permanent than the latter. Another point requires consideration—are Antispasmodics stimulants or sedatives? If my hypothesis be correct, they must operate by a sedative influence; for, if the irregular or inordinate action which they overcome be the consequence of irritation, either mental or corporeal, it follows that, in resolving spasm, the susceptibility of impression in the extreme motor nerves must be diminished; and this can only be the result of a sedative power. It may, however, be affirmed that this must either be immediate, or consecutive of a previous stimulant operation; thence we can explain the reason why

some of those medicines, which can only be regarded as direct Antispasmodics, stimulate the general system, and, consequently, quicken the pulse; since, like narcotics, this action may be primarily of a stimulant character, and be quickly followed by collapse. According to this mode of reasoning, the same results may follow from Antispasmodics operating exclusively on the motor nerves, as from Narcotics operating on those of sensation.

The effects of Antispasmodics are generally perceptible very soon after their administration. But this must necessarily depend on the cause of the spasm, whether it arise from exhaustion and collapse; such, for example, as occurs from blood-letting, when the quantity of the vital fluid abstracted is more than the condition of the system can support; in which case, nothing is more common than for syncope to be attended with convulsions; or whether it depend on the opposite state, fulness of the vessels of the brain, sufficient to produce epilepsy, or on some degree of inflammation, as in phrenitis, which is sometimes also attended with convulsions. It should ever be remembered, that although Antispasmodics are indicated and proper in the first state, just described, yet, that this class of medicines is positively injurious when the spasmodic action is the consequence of inflammation of the brain or spinal marrow, or their coverings: under such circumstances, blood-letting and measures calculated to subdue the primary disease are the means to be adopted. It is also necessary to recollect, that the operation of Antispasmodics is very transient, and that by frequent repetition their influence on the nervous system is much impaired: the dose, therefore, requires to be greatly modified, according as the patient has or has not been accustomed to their influence.

Antispasmodics, as far as regards their mode of operating, may be divided into *Direct*, or those which exert their influence on the nervous energy, but neither as narcotics nor tonics: and *Indirect*, or those which, being narcotics and tonics, produce an antispasmodic effect.

TABLE OF ANTISPASMODICS.

A. DIRECT ANTISPASMODICS.

* *Organic Products.**a.*—ANIMAL RESIN—*combined with Volatile Oil, in*

Musk,

Var. *α.*—Chinese Musk ;*β.*—East India Musk.

Castor,

Var. *α.*—Russian Castor ;*β.*—Canadian Castor.*b.*—EMPYREUMATIC OIL :—contained in

Dippel's Oil ;

Oil of Amber.

c.—VOLATILE OIL—inValeriana *officinalis*. 3. 1. Valerianeæ.*d.*—GUM-RESIN—inFerula *Assafætida*. 5. 2. Umbelliferæ.———— *Communis*. —. —. —————Bubon *Galbanum*. —. —. —————Pastinaca *Opopanax*. —. —. —————* * *Inorganic Substances.**e.*—BITUMENS :—

Naphtha ;

Petroleum ;

Asphaltum.

B. INDIRECT ANTISPASMODICS.

* *Material.**f.*—TONICS and NARCOTICS.* * *Mental.**g.*—FEAR.*h.*—ABSTRACTION.

ORGANIC ANIMAL AND VEGETABLE PRODUCTS WHICH
OPERATE AS DIRECT ANTISPASMODICS.

1. MOSCHUS, MUSK, L. E. D.—This is the secretion of an animal having a near affinity to the deer tribe, the *Moschus moschiferus*, a native of Thibet, China, and Siberia; belonging to the Ruminantia of Cuvier*. The Musk is contained in a bag, which lies close to the skin of the lower belly of the animal, immediately before the prepuce; consequently it is an appendage only of the male. This bag is a flat oval, covered on the convex surface with stiff hairs, and lined by an irregularly plaited membrane: it has a small orifice. It is always full of Musk in the adult, and empty in the young male; and the quantity is greater, and the quality of the Musk better, if the animal be taken during the rutting season. The skin which covers the musk bag has few vessels, but the cellular matter contains a great many; and the bag, internally, presents small, unequal valves. The Musk Deer is a timid animal: it rarely appears during the day; consequently, the Musk collectors watch and surprise it at night.

Two kinds of Musk are found in the market—in one variety, the Tonquin or Chinese, the bag is covered with reddish or cinnamon-coloured hairs: in the other, called Kaburetin, or East Indian, it is covered with coarse white hair. The Tonquin is the best: it should always be bought in the *pod*, or natural bag. The Bengal Musk is inferior to it in every respect; and a still baser sort is brought from Russia, the production of Siberia. The Musk itself is in concreted, brown, granular masses, slightly unctuous, and perfectly free from grittiness when rubbed between the fingers. It is bitter and somewhat acrid to the taste; its odour powerful and astonishingly durable. In many individuals the odour of Musk causes headache; and, in some instances, when it is strong, convulsions have been induced by it. It is inflammable, and, when burnt, leaves a light, spongy charcoal. Boiling water takes up about eighty parts in one hundred of Musk; the infusion affords precipitates with sulphate of iron, bichloride of mercury, nitrate of silver,

* Regne Animale, t. i., p. 251. London Dispensatory, 6th edit. p. 444.

and infusions of astringent vegetables. Alcohol dissolves fifty parts in one hundred: the tincture is of a reddish-brown colour; it gives out scarcely any odour of the Musk, unless water be added to it, which instantly develops the odour and renders the infusion milky. Ether takes up nearly the whole of the Musk.

According to the analysis of Blondeau and Guibourt, Musk consists of—stearine; elaine; cholesterine; a volatile oil; an acid oil combined with ammonia; free ammonia; muriates of ammonia, potassa, and lime; an intermediate acid, combined also with ammonia, potassa, and lime; gelatin; albumen; fibrin; a carbonized matter, soluble in water; carbonate and phosphate of lime; water*. In this long list no mention is made of resin; which, however, can be readily separated by ether, from which it is deposited on the surface of water.

Musk, in moderate doses, operates as an excitant to the nerves of the stomach; causing, when this organ is in an irritable state, nausea, and a sensation of heat at the epigastrium. If the dose be repeated at short intervals, it acts as a general excitant, increasing the force and quickness of the circulation, and exciting perspiration. It is taken into the circulation, and the odour of the drug becomes evident in the urine, the sweat, and other excretions: and, in post-mortem dissections of persons under a course of Musk, every cavity and tissue are found to be penetrated with it.

Musk is more employed as an Antispasmodic on the Continent than in Britain, which is partly attributable to the high price of the drug. It has been found useful in hiccough, palpitation of the heart, and in spasms of the stomach and intestines, depending on some sympathetic irritation of the spinal and ganglionic nerves, when administered in doses of a scruple, repeated every four hours†; and, at the same time, it acts as a cordial and diaphoretic. In epilepsy, Musk has been highly extolled: but the causes of this disease are so various, that the remedy which is valuable in one case, is perfectly useless in other instances of the disease. When the disease is periodical, and apparently connected with some derangement merely of the nervous sys-

* Guibourt's *Hist. de Drogues Simples*. † Clark on Diseases of Long Voyages.

tem, then Musk may prove beneficial : but if it arise from any organic affection of the encephalon, or from any mechanical irritation within the cranium ; from hypertrophy of the left ventricle of the heart ; or from any causes of a similar kind, then is Musk of no value. When the epileptic attacks are idiopathic, if no causes such as I have enumerated are very obvious, we may anticipate some benefit from the administration of Musk, provided the dose be carried to its full extent. Thus, in one very severe case which came under my care, the dose was carried to the extent of ʒi, and repeated every sixth hour. The intervals were lengthening in a very striking manner ; so that, instead of the attack occurring three times a day, it was protracted to once in six weeks. In judging, however, of the value of Musk as an Antispasmodic, we must take into account both the genuine character of the medicine and the condition of the habit at the time of prescribing it ; when the medicine is good, and given in large doses, and the circumstances are such as fairly indicate its employment, Musk may be regarded as a useful antispasmodic ; but less so than many others.

δ. CASTOREUM, Castor, L. E. D.—'This is also an animal secretion, peculiar to the beaver, Castor *Fiber*. It is deposited in peculiar sacs, of a periform shape, situated beneath the skin of the abdomen, in an opening common to the parts of generation and the anus of the animal. The beaver is an amphibious animal, inhabiting rivers and lakes in the North of Europe, Asia, and America ; belonging to the class Rodentia of Cuvier*. The best Castor is that which comes from Russia, but it has been very rare of late years ; and almost all now found in the market is imported from Canada : the former is in roundish, solid pods, smooth on the outside, and, when cut, presenting an orange-coloured surface : the pods of the Canadian are oblong, thin, and corrugated on the outside, and their contents deeper coloured than those of the Russian. The Russian, when treated with ammonia, affords a whitish, the Canadian an orange-coloured product. Castor has a strong, peculiar, somewhat aromatic odour ; and a bitter, sub-acrid taste. The odorous principle is dissipated in forming

* Regne Animal, t. i, p. 189. London Dispensatory, art. Castor.

the decoction, which displays an alkaline reaction. Both alcohol and ether take up all the active principles of Castor, and retain its odour and taste.

Various analyses have been made of Castor. According to Bonn, it contains an etherial oil, cholesterine, resin, lime, iron, and some salts : Bouillon Lagrange and Laugier found in it a volatile oil, benzoic acid, resin, adipocine, a colouring principle, mucus, subcarbonate of potassa, lime, ammonia, and iron. M. Bizio obtained from it a peculiar crystalline matter, which he called *Castorine* ; having the odour of the Castor, and a styptic taste.

Castor is supposed to operate chiefly on the cerebro-spinal nerves : in moderate doses, it causes a sensation of heat in the stomach, and accelerates the pulse. It enters the circulation, and displays the presence of its odorous principle in the urine. Its influence in hysteria and other spasmodic affections was at one time conceived to be considerable : but more recent experience has not confirmed this opinion. The dose of Castor is from gr. x to ℥i, but it may be given to almost any extent.

c. ANIMAL OIL OF DIPPOL.—This is a volatile oil, procured by the distillation of bones, albumen, and gelatin, in close vessels. It floats on the water which passes into the receiver, from which it can be easily separated. It is altogether the result of the process.

Dippol's oil is more or less coloured, transparent, and thick, according to the degree of heat employed to obtain it : its odour is strong and unpleasant, yet somewhat aromatic. It is very volatile, partially soluble in water, and greens the vegetable blues, owing to the ammonia which it invariably contains ; from which, however, it may be separated by means of hydrochloric acid. All the acids dissolve it, forming imperfect soaps. Strong nitric acid sets it on fire. It combines with alkalies, oil, alcohol, and ether ; and is much deepened in colour by exposure to the air and light. It possesses the singular property of burning well in an atmosphere containing only eighteen per cent. of oxygen.

This oil, which received its name from Dippol, a German chemist, who first procured it, was at one time regarded as a

powerful Antispasmodic, and employed in epilepsy by Boerhaave, Juncker, and Hoffman. Dippel's oil has, nevertheless, deservedly fallen into disuse in the treatment of epilepsy, although it is still used on the Continent in symptomatic cases of this disease. Alibert made some experiments with it in epilepsy, at the Hospital of Saint Louis, and found that it prolonged the intervals between the fits; but it did not appear to diminish the violence of the disease.

d. SUCCINI OLEUM, Oil of Amber, L. E. D. is a pyrogenous oil, procured by destructive distillation from Amber; it is solely the production of the process.

Amber, Succinum, has been regarded as a gum-resin; but a recent analysis of Berzelius has separated it from the gum-resins. It may, however, be regarded as a modification of resin, as it has more analogy to the resins than to any other substances. Berzelius found it to contain—a small quantity of volatile oil; a yellow resin intimately combined with this oil; another resin little soluble in cold alcohol, but soluble in ether, alkalies, and boiling alcohol; and a principle closely resembling *lac*. Amber is found in various parts of the world, but in greatest quantity in coal strata, on the shores of the Baltic. As the strata containing it run under the shores of the Baltic, it is thrown up by storms, and is found floating on the banks of Samland near Pillaw. There are two subspecies of Amber:—1. The white, which has a pale straw colour; and, 2. the yellow, which has the colour of yellow wax, passing into yellowish brown and hyacinth red. It is a brittle, transparent, light, inflammable substance, possessing considerable lustre, and a sp. gr. 1.065. It is insipid, and its odour is slightly fragrant when it is pulverized: it is scarcely soluble in water at any temperature; is slightly so in alcohol, but dissolves in boiling liquor potassa, forming a saponaceous solution not decomposed by water. Sulphuric acid acts upon it in the cold, converting it into a dark coloured resinous mass: nitric acid does not decompose it, but, by long boiling in it, the amber is dissolved. Muriatic acid and the weaker acids do not act upon it.

When Amber is distilled, an oil and succinic acid come over. This oil redistilled has a strong ungrateful odour and a hot, acrid taste; is light, volatile, and inflammable; inso-

luble in water, and only partially soluble in alcohol; and resembles naphtha more than oil.

Oil of Amber possesses antispasmodic powers, and was formerly administered, internally, in hysteria and other convulsive diseases, in doses of from five to twenty minims, diffused in aqueous fluids by means of mucilage. It is now scarcely ever used. It is still, however, externally employed; and seems in this form, also, to display antispasmodic powers. It is the active ingredient in an empirical embrocation, Roche's, which has obtained much celebrity for curing whooping cough. Mr. Brande informs us that this embrocation is a compound of equal parts of Amber and oil of cloves, dissolved in two parts of olive oil. It is of little value, and greatly inferior, as an Antispasmodic, to belladonna and conium, in this disease.

e. VOLATILE OIL.—All volatile oils possess more or less antispasmodic powers; but that immediately before us is a component in the root of the *Valeriana Officinalis*, a plant which is a native of Greece and the temperate parts of Europe, the type of the natural order Valerianæ*. In high situations Valerian roots contain not only more volatile oil, but that which they possess is of a more stimulant nature than when the plant grows in low and moist situations; and those plants only ought to be employed which are grown on elevated spots. The strong peculiar odour of Valerian is due to the volatile oil which the roots contain; its odour in a confined situation affects strongly the brain, and produces symptoms of intoxication in some quadrupeds, more especially the cat, who is powerfully attracted by it. Tromsdorff analysed Valerian, and obtained—a peculiar principle soluble in water but insoluble in alcohol; a dark-coloured resin; a volatile liquid oil, camphor, fecula, a gummy extract, and lignin†. Valerian is administered in the form of powder, infusion, extract, and tincture. The extract is a useless form of preparation; and, although the infusion possesses some of the active properties of the plant, yet it is undoubtedly less powerful than either the alcoholic or ammoniated tincture. Where there is much nervous irritability, accompanying a weak and languid cir-

* Woodville's Med. Bot. 3rd edition, p. 77, pl. 32. London Dispensatory, art. Valeriana.

† Bulletin de Pharmacie, tome i.

culatation, and more especially in hysterical habits, the ammoniated tincture of Valerian has been found very beneficial. It seems to act chiefly by soothing the nervous turbulence. With regard to its general antispasmodic powers, there is much diversity of opinion. In epilepsy, it proves useful only when the disease is symptomatic, in which case it both shortens and weakens the force of the paroxysm and lengthens the intervals. It has also been employed in chorea and catalepsy, but with little advantage. In asthma, its influence is considerable in relieving the paroxysm; and, if no inflammatory action exist, in conjunction with sulphate of zinc, in the intervals, it tends to ward off the attacks. Tissot was of opinion that much of the apparent diversity of its action depends on the condition of the patient; and he found that it often afforded much relief after the use of the lancet, when it had previously failed to produce any benefit.

It may be given in the form of powder, in doses of ʒi to ʒii; but the tinctures are preferable, especially the ammoniated tincture, when circumstances permit it to be used.

f. GUM-RESIN.—All the antispasmodic Gum-resins are secretions of plants belonging to the natural order Umbelliferae. They are combinations of resin, gum, extractive matter, volatile oil, and some other substances. The resins and oil are soluble in alcohol; the gum and extractive in water: thence proof-spirit is the proper solvent of Gum-resins. They are soluble also in the alkalies; but not in sulphuric ether. The following table displays, at one view, the composition of the antispasmodic Gum-resins.

Components in 100 parts,	Assafoetida according to Pelletier.	Galbanum according to Pelletier.	Sagapenum according to Pelletier.	Opopanax according to Pelletier.
Resin	65.00	66.86	54.26	42.0
Gum	13.60	19.80	33.34	33.4
Volatile oil	3.60	—	10.20	5.9
Wax	—	—	—	.3
Extractive	—	—	—	1.6
Fecula	—	—	—	4.2
Lignin	—	—	—	9.8
Bassorine	11.66	—	—	—
Malate of lime . . .	0.30	—	—	—
Malic acid	—	—	—	2.8
Loss	5.04	4.34	2.20	—

1. *Assafœtida*. L. E. D.—This is the concrete proper juice of the root of the *Ferula Assafœtida*, a native of Persia*. In the recent root, this secretion is in the form of a thick, milky-looking, fœtid juice, which, when inspissated by spontaneous evaporation, is the *Assafœtida* of the shops. It is collected at that season of the year when the stem of the plant, which is annual, is beginning to wither. This is separated or rather torn from the root, which is then laid bare by digging the earth from it, and sliced transversely. The milky juice instantly exudes, and, after being left for forty-eight hours to inspissate, is scraped off, and a fresh surface exposed by another transverse slice: and in this manner the root is exhausted.

Assafœtida is in irregular masses, adhering to one another, externally of a brownish-yellow colour, interspersed with shining tears of a whitish, or reddish, or violet hue. The clearer the mass, the paler the redness, and the more numerous the tears are, the better is the *Assafœtida*. It is sometimes, but very rarely, seen in the form of tears, or distinct, small, granular masses, of a dull-white colour, a very sharp taste, and a most powerful odour. This is the finest kind of *Assafœtida*. The odour is extremely disagreeable, somewhat like that of garlic: thence the appellation applied to it of *Stercus Diaboli*. The taste is bitter and subacid. By exposure to the air it becomes brittle; but, even in this state, it cannot be pulverized unless it be triturated with carbonate of ammonia. It is heavier than water, its specific gravity being 1.327. *Assafœtida*, when triturated with water, forms a milky-looking emulsion, which gradually lets fall the resin. Alcohol, digested on it, dissolves about sixty-five per cent. which is nearly pure resin: the addition of water renders the tincture milky; but it is not precipitated by that fluid. Its odour, and probably much of its medicinal power, depends on the volatile oil, which can be separated by distillation with water: it amounts to scarcely four per cent. Brugnatelli regards what has been termed gum as extractive; but, when the watery emulsion is shaken in chlorine, no extractive is separated; and no precipitate is produced by muriate of tin dropped

* Woodville's Med. Bot. third ed. p. 10, pl. 43. London Dispensatory, art. *Assafœtida*.

into the aqueous solution. Assafœtida, according to Brandes, contains also traces of phosphorus, and several earthy salts, with sulphate of iron. Its active principle is undoubtedly the volatile oil. Besides forming an emulsion with water, Assafœtida is soluble in vinegar, proof-spirit, and in the yolk of egg*.

Assafœtida is a stimulant Antispasmodic, and, as such, has been much administered in asthma, hooping-cough, and other spasmodic diseases. Cullen regarded it as the best of the expectorants in asthma; but much is due to its power of resolving spasm. The usual dose is from five grains to half a drachm: the best form of administering it is that of pill, as the resin separates in the emulsion. The alcoholic solution is also a good form: it contains both the oil and the resin: and, as no precipitation takes place when water is added, the diluted tincture may be regarded as containing all the active properties of the gum-resin. It has been found serviceable as an Antispasmodic when applied externally; and, for this purpose, it is easily formed into a plaster by triturating it with camphor, which promotes its softening.

Assafœtida appears to act particularly on the spinal nerves, in a manner not well understood: it is equally serviceable whether taken into the stomach or injected into the rectum. When it disturbs the action of the stomach, the heart, the diaphragm, or the respiratory muscles, there is reason to suspect some organic affection, either of the brain or of the spinal marrow; in which case it should not be employed.

2. *Galbanum*, L.E.D. is the secreted juice of the Bubon *Galbanum*, a native of Asia and Africa†. This juice is obtained by wounding the stem of the plant a few inches above the root: it flows freely, soon concretes, and in this state is scraped off

* The ancients used Assafœtida as a condiment, under the name of Silphion and Laserpitium. In Persia, it is still esteemed as a condiment, and mixed with almost all their dishes. Gastronomes, as the French term those who delight in the pleasures of the palate, among the moderns, employ it for the same purposes; having the hot plates on which they eat beef-steaks rubbed with it. The Hindoos use it also as a condiment, and the Arabians consider it an aphrodisiac. Dioscorides states that the best in his time came from Cyrene.

† Woodville's Med. Bot. third edit. p. 98, pl. 40. London Dispensatory, art. Bubon.

the stem. It is in masses, composed of whitish tears, interspersed in pale brown or yellowish substance: its odour is terebinthinate; its taste bitter, warm, and acrid; its specific gravity 1.212. Water dissolves about one fourth of its weight, forming a white opaque emulsion, from which the resin is afterwards gradually deposited. Alcohol takes up one fifth of its weight: its proper solvent is proof spirit. The tincture is of a pale yellow hue, and possesses all the active properties of the gum-resin. Ether takes up the resinous part of Galbanum. By distillation it yields a volatile oil, of an indigo-blue colour; on which the active properties of the Galbanum appears chiefly to depend. Besides the analysis of Pelletier, M. Meisner has given the following as his view of its constituents: Resin 65.8, Gum 22.6, Cerasin 1.8, Malic Acid 0.2, Volatile Oil 3.4, Impurities 6.2, in 100 parts. Galbanum possesses antispasmodic properties in a slight degree. It enters into the composition of several pills and other compounds. It may be given in doses of gr. x to 3ss, either in the form of pill or that of emulsion. It was formerly much prescribed in hysteria and convulsive affections; but the moderns justly regard it as much less active than assafœtida, which it resembles, and, therefore, it is now seldom employed.

3. *Sagapenum*, L.E.D. This gum-resin is of obscure origin, although it was described by Dioscorides, and stated by him to be the produce of a ferula growing in Media. Wildenow refers it to the *Ferula Persica*, whilst others regard it as the proper juice of the *Ferula communis*. It is a question of little interest, as the powers of *Sagapenum*, as an Antispasmodic, are very inferior to assafœtida.

OPOPANAX, L.D. The plant which yields this gum-resin is also a *Ferula*, according to Springell; but according to Wildenow, whose authority is followed by the British Colleges, it is the production of the *Pastinaca Opopanax*; a native of Greece, Italy, and the South of France*. It is procured both from the stem and the root. When inspissated, it is of a reddish-yellow colour, variegated with large white pieces. It forms a milky solution with water; but one half of the opop-

* Woodville's Med. Bot. third edit. p. 122, pl. 47. London Dispensatory, sixth edit. art. *Pastinaca*.

anax only is taken up, and the emulsion gradually deposits resin. Proof spirit is its proper solvent. As an antispasmodic, it is decidedly much inferior to assafœtida; and is, therefore, seldom prescribed.

* * INORGANIC SUBSTANCES OPERATING AS DIRECT
ANTISPASMODICS.

BITUMENS. — These are inflammable substances, found either in the earth or issuing from its surface. The medicinal Bitumens are Naphtha, Petroleum, Mineral Tar, and Asphaltum.

1. *Naphtha* is found in various parts of the world. In the year 1802 a considerable spring of it was discovered at Amiano, in the State of Parma. In Persia, Naphtha is found so pure, that, without rectification, it is fit for preserving potassium and sodium from the action of the air. When in this state, Naphtha is a fluid of great limpidity; its odour is agreeable to most persons; it is very volatile and considerably lighter than water, having a specific gravity of 0.80; and, when highly rectified, of 0.758. It expands greatly in the air; and, like ether, forms an atmosphere which inflames on the approach of any ignited body. In burning, it exhales a thick smoke, and leaves no residue. When kept exposed to the light and air, it becomes thick, brown, and approaches in character to Petroleum. In truth, these three substances, Asphaltum, Petroleum, and Naphtha, are modifications of one another. When natural Petroleum is distilled, Naphtha comes over and Asphaltum remains in the retort; and when it is exposed to the air, it first becomes Maltha, or mineral pitch, and afterwards, in process of time, hardens into Asphaltum: and thus we can trace the transition from Naphtha to Petroleum, from Petroleum to Maltha, and from Maltha to Asphaltum. Naphtha contains no oxygen, and is therefore used to preserve the highly oxidizable metals. It consists of six prop. of Carbon = 36, + five of Hydrogen = 5, making the equivalent 41.

Naphtha was formerly much employed as an Antispasmodic in hysteria, asthma, and similar affections, when these were unattended with inflammatory symptoms. Its operation in

many respects resembles that of the volatile oils, particularly of oil of turpentine; and, like turpentine, it has been advantageously administered in tape worm. The West Indian practitioners extol it as an external application in whooping cough, and other spasmodic diseases. I have never employed it.

2. *Petroleum* is more opaque and more unctuous to the touch than Naphtha. The substance called Barbadoes tar is Petroleum. It is of a dark greenish colour, and combines with fat, resins, volatile oil, and camphor.

3. *Asphaltum* is a solid bitumen, of a black colour and a vitreous lustre: it has a conchoidal fracture, and is very inflammable. It is a more general production than Naphtha: is found in many parts of the world; but especially in the Dead Sea, in Judea, whence it is procured in great abundance. There are extensive mines of it in Switzerland, in France, and in Germany. Naturalists are divided in opinion respecting the origin of Asphaltum; some asserting that it is of vegetable origin, others deriving it from the mineral kingdom. By distilling Asphaltum, artificial Naphtha is procured. Asphaltum dissolves or rather melts in heated oil, and forms a varnish: it was also, formerly, an ingredient in the compound employed for embalming the dead.

Asphaltum has been employed as an Antispasmodic; but with very little advantage, and, therefore, is now almost wholly rejected from practice in this country.

B. INDIRECT ANTISPASMODICS.

* *Material.*

f. TONICS AND NARCOTICS.—With respect to Indirect Antispasmodics, I have little to say: they consist chiefly of tonics and narcotics. In selecting them, we must be guided by the condition of the patient and the nature of the exciting causes of the spasms which they are intended to relieve: if these be the result of local irritation, kept up by habit after the irritating cause is removed, then *narcotics*, by allaying this irritation, and breaking the habit, are undoubtedly the best Antispasmodics; but, if the spasms are maintained, not so much by habit as by a peculiar susceptibility of impression,

which is always more or less connected with debility, then *tonics* are to be preferred ; and the sooner the body can be brought under their influence, the better.

* * *Mental.*

g. FEAR.—In no instance is the remedial influence of mind more strikingly illustrated than in spasmodic diseases. Mental impressions are of two kinds—*elevating* and *depressing*. I have already endeavoured to explain in what manner Joy, Confidence, and other agreeable sensations, operate upon the nervous energy in the same manner as material stimulants ; and, if we admit this to be true, we can have little difficulty in comprehending that the depressing passions may operate nearly in the same manner as direct sedatives. In order to understand how *Fear* produces its effects as an Antispasmodic, it is necessary that we should clearly comprehend the meaning of the term, as it has, in many instances, been confounded with *Apprehension* and *Terror*. Now, *Apprehension* implies a dread of something which hangs over the future, but is not immediate : *Terror* is an impression of some danger so immediate as to threaten instant destruction, but which, nevertheless, is of a nature to rouse a voluntary effort for self-preservation ; or it may be of a kind which presents no prospect of hope, and which consequently paralyzes the nervous energy to such a degree, that often an instantaneous cessation of every vital function is the result, and death follows. *Fear* is an intermediate state—one which contemplates the cause, and in which, as no immediate effort of muscular energy is necessary to be exerted on the voluntary muscles, these share the general torpor of the rest of the body. Let us examine what are the corporeal effects of this passion.

When a person is suddenly alarmed, the blood seems to recede from the surface, which instantly becomes pale, the respiration ceases, the action of the heart is so much weakened that it does not expel half its contents ; consequently, the pulse becomes small and quick, and a sensation of chilliness is felt over the whole of the skin. But, during this period, the muscular power, in several parts, is exerting a kind of temporary spasmodic contraction ; the abdomen is drawn in-

wards, whilst the breath is suspended; the arms and the limbs are fixed in the position they assumed at the moment of the alarm; and, whilst this continues, spasm, instead of being relaxed, is confirmed. Such a state, however, cannot long continue; and the natural consequence of so powerful an excitement is a corresponding state of collapse: every muscle is relaxed, and those which were previously in a state of spasmodic contraction necessarily share in the change which has taken place. Two queries naturally arise upon this explanation—has the resolution of a morbid contraction of muscles ever resulted from the influence of Fear? and can we employ this agent as an Antispasmodic? In replying to the first query, I say that we see its effects in resolving spasm by its influence on the sphincter of the bladder, so that a smaller than usual stimulus of the urinary secretion is required to cause this muscle to yield; a well-known effect of Fear being a frequent and involuntary discharge of urine; and perhaps the diarrhoea which also commonly attends fear may be explained on the same principles. If, therefore, few direct cases of fear having actually relaxed morbid spasm can be brought forward, still what is known of its effects is sufficient to prove that it exhausts the nervous energy and produces a state of collapse, so suddenly that the relaxation of spasm cannot fail to follow; and there is certainly no reason why so powerful an agent should not be employed when other and more ordinary means fail. I recollect a striking instance of its sanative effects in hooping-cough kept up by habit. The patient, a young boy, was threatened with the application of a large blister: although it was not applied, but merely placed within his view, yet the dread of it completely removed the cough. The story also which is related of Boerhaave, who cured epilepsy in a whole school, by marching into it at the moment of the expected attack with a red-hot poker, which he threatened to push down the throats of those who should have a fit, can only be explained on this principle. It is the duty of the physician to take advantage of every means likely to destroy diseased action; and it is rather wonderful that, in some spasmodic affections, Fear has not been more employed as a remedy.

h. ABSTRACTION.—If there are few cases to illustrate the influence of Fear as an Antispasmodic, many might be brought forward to demonstrate the powerful effect of abstracting the attention in cases of spasm. What is Attention? This is a question which must be answered before we can form any accurate idea of the manner in which abstraction can operate as an Antispasmodic. We can have no sensation of any kind without a perception of the mind, connected with the impression which is supposed to originate the sensation. Thus, a part of the body is touched with a hot iron: the pain is the consequence of the attention being roused, and of the mind receiving a perception of the injury; and the continuance of the pain is chiefly the result of an effort of the mind detaining this perception, to the exclusion of every other object that solicits its notice. Now, if any more powerful impression can be made, so as to abstract the mind from this perception, while the effect thus produced continues, the pain is not felt; and it is only when this quickly ceases to occupy the attention that memory operates in again directing the mind to the seat of pain, and renewing the sensation. That this is a purely mental operation will not appear extraordinary, if we reflect on the evanescent nature of many impressions which are the causes of distinct efforts of the mind and yet cannot be recollected—nay, even appear never to have been present to the mind. Thus, if we are reading aloud, every letter, and every combination of letters must produce a distinct impression; yet, the attention being directed to the meaning of the pages, and not to letters and words, there is no consciousness or rather no memory of the impressions ever having been made, although it is possible that two thousand letters may have been objects of perception in the space of every minute. Now, in the case of spasmodic action, the mind is directed solely to the seat of the spasm; and, as long as this exists, no corporeal agents that do not cause an impression greater than that which produced the spasm can in any degree relieve it; but, abstract attention from the seat of the spasm, and it is instantaneously resolved. This is beautifully illustrated in the reduction of luxations. A man has his shoulder luxated; various ineffectual attempts are made to reduce it, owing to the spasm which has super-

vened, and which is maintained by the attention of the patient being directed solely to the part; abstract the attention by any means, the spasm instantly yields, and the head of the humerus slips into its socket. It is unnecessary to pursue this subject farther: there is no doubt that both Fear and the sudden Abstraction of Attention may be successfully employed as Antispasmodics; but, in admitting this, we must, at the same time, confess that great discrimination and judgment are requisite to determine the circumstances under which their employment is applicable.

Practical Employment of Antispasmodics.

Antispasmodics exert their remedial influence only in one order of diseases, the Spasmi. *Tetanus*, one of the most striking of these, displays spastic action, attended with spasm in many muscles, both voluntary and involuntary: and although a certain degree of relaxation takes place after each exacerbation of spasm, yet, the spastic action prevails so considerably, even during the intervals, that every voluntary muscle may be said to be literally on the rack. In such a case the narcotic Antispasmodics—for example, opium, musk, and camphor—have been given in the amplest doses with little effect; nor has their influence been much augmented by the additional aid of the warm bath and other relaxant measures. If any Antispasmodic, however, can prove useful, it must be a narcotic; and it is almost incredible what doses of opium can be borne in this disease. Cases are recorded in which fifteen and twenty grains of opium were administered every three hours, for eight and ten days successively, with little effect upon the habit or the disease. When opium has proved beneficial, its effects have been rarely perceived until after the tenth or twelfth day. But although opium has occasionally succeeded, yet little reliance is to be placed upon the influence of even the most powerful Antispasmodics in tetanic affections.

In chorea, the spasms are of a very distinct character from those of tetanus: the disease displays itself by sudden jirking movements of some of the voluntary muscles, especially when called into action by the power of the will. It is a disease of debility, and generally attacks children and young people

under the age of puberty ; but, after it has made its attack, the disease has run on to an advanced period of life. Under the idea that the spasmodic action may depend on some source of irritation in the intestinal canal, the use of purgatives has been assiduously resorted to ; and some of the most drastic have been administered in very large doses. When purgatives fail to produce relief, Antispasmodics, such as belladonna, musk, and opium, have been largely administered. More decided benefit, however, has been obtained from tonics than from any other Antispasmodics. They operate by supporting the habit under the debilitating influence of the spasms. Oxide of zinc, the sulphates of copper and of zinc, and many of the vegetable Antispasmodics, have failed in granting any relief ; but I have seen much benefit and many cures effected by the use of nitrate of silver, carbonate of iron, and arsenious acid ; all of which come under the title of tonics, and consequently are *indirect* Antispasmodics. Cases indeed have occurred in which the disease has yielded to the antispasmodic influence of musk and camphor, after those powerful tonics have failed ; but, in general, we may conclude that in this disease, as in tetanus, less benefit has followed the employment of direct Antispasmodics than, from the nature of the disease, might have been reasonably anticipated.

Antispasmodics have effected little benefit in idiopathic epilepsy. This disease may arise from various causes : it is not an unfrequent attendant on mania ; sometimes it is connected with some irritation of the uterine organs, and occasionally it follows the improper repulsion of exanthematous eruptions. When arising from such causes, it may either cease of itself or yield to remedies of a nature adapted to that of the exciting cause ; but sometimes it is the consequence of mechanical irritation in the brain, or of other causes, which cannot be discovered till after death. I have seen every kind of Antispasmodics, both direct and indirect, employed in this intractable disease, with very various advantage. The narcotic which has had most reputation is the stramonium ; but, like all other narcotic Antispasmodics, it as frequently fails as it succeeds. Among the metallic tonics, the

preparations of zinc, mercury, copper, and arsenic, have each had its share of transitory reputation. Of these my own experience would induce me to give the preference to those of zinc; but the metallic tonic on which the most confidence may be placed, as an Antispasmodic, in this disease, is nitrate of silver. Many cases of its efficacy might be cited; and it is remarkable that it always proves most beneficial in those cases in which it opens the bowels. The manner in which these salts operate as Antispasmodics is by diminishing the susceptibility of the habit to irregular action, which is always in proportion to the degree of debility present. In this disease the direct Antispasmodics may be regarded as useless.

In asthma, the direct Antispasmodics have been found highly beneficial, particularly in that variety of the disease in which the muscular coat of the bronchiæ is thrown into spasmodic action. This often depends on a peculiar predisposition connected with original conformation, in which it is not very probable that the disease will be cured; but much may be done to alleviate the urgency of the symptoms. Among the direct Antispasmodics, assafœtida is most to be depended on, taking care that no inflammatory state of habit exists at the time of prescribing it. Among the indirect Antispasmodics, every thing to be expected from this set of remedies may be obtained from opium and stramonium. The paroxysm of genuine spasmodic asthma will seldom resist a full dose of opium; but it must be given in that form in which its effects will be most rapidly induced: I have found from thirty to sixty drops of Sydenham's liquid laudanum relieve the paroxysm sooner than any other form of the remedy. I am rather surprised that opium has not been smoked, in the manner in which the Chinese employ it, for the relief of asthma, in this country: as stramonium proves serviceable when used in this manner, opium is more likely to do so; at least, the experiment is certainly worthy of being tried.

In hooping cough, the direct Antispasmodics have been little employed; but some of the indirect among the narcotics—for example, belladonna and conium—are the chief remedies to be relied upon. When the spasmodic cough is kept up by

habit, I have seen much advantage result from the use of indirect Antispasmodics, particularly oxide of zinc, in an alkaline solution.

In colic, the benefit to be expected from Antispasmodics depends much upon the exciting causes of the attack. In simple constriction the narcotics will answer every indication; but when flatulence is the exciting cause, assafœtida and other direct Antispasmodics will be found serviceable.

In no disease have Antispasmodics more satisfied the anticipations of the practitioner than in hysteria. This is a disease depending on an irritable state of the nervous system, in which inordinate and irregular muscular contractions occur with alternate remissions and exacerbations. Being a disease of females, and occurring at that period of life when irritability is in excess, and every impression, both corporeal and mental, produces much effect upon the excitability of the nerves, the character of the disease is greatly modified by the degree of relaxation or of tone in which the individual is at the time of the attack. The convulsions are often of the most frightful description; every muscle seems to share in the inordinate action, even the heart and diaphragm, if we may judge from the hiccough and palpitation which frequently accompany the paroxysm, and the extreme exhaustion which supervenes, and the apparently lifeless state in which the patient appears when the fit ceases. During the paroxysm, the direct Antispasmodics, especially assafœtida and valerian, have been found very serviceable, when prescribed in sufficient doses, which is rarely the case. It is the custom to order from gr. v to gr. x of the gum-resin in the solid state; or from m. xxx to fʒi of the tincture in these cases; but I am satisfied that little benefit can be expected, unless the doses be large. In the intervals, the indirect Antispasmodics, especially the metallic tonics, should be chiefly relied upon; and, indeed, it is only by endeavouring to correct the morbid predisposition, at this time, that any permanent benefit can be expected from medicines in hysteria.

From what has been said, it is evident that the range of this class of medicines is extremely limited; and, in fact, that every thing which the substances placed in it can effect, even

as direct Antispasmodics, may be accomplished by other orders of medicines—purgatives, diaphoretics, narcotics, and tonics. At best, Antispasmodics can be regarded only as auxiliaries; and the spasm and convulsions are less to be considered than the causes which induce them: remove the cause, and the effect will cease.

SECTION VII.

TONICS.—MEDICAMENTA TONICA*.

Syn.—*Corroborants*.

By the term Tonics, we are to understand those medicinal agents that restore the strength and the vigour of the body when it is weakened and relaxed. To comprehend this definition aright, we must take a view of these two opposite states.

When an individual is in good health, and in vigour of body, the muscles or moving organs feel firm and tense; they act regularly and powerfully, whether they are involuntary muscles, or those under the controul of the will. This is a state of *healthful tone*. On the contrary, when the muscles feel soft and flabby, when the action of the involuntary muscles is languid and the voluntary do not rapidly respond to the will, when there is a strong inclination for rest and indulgence; and when the movements of the body or its parts are performed with difficulty, this is a state of *deficient tone* or *debility*. That both these states are connected with the condition of the muscular fibre, may be demonstrated by detaching a muscle from the bodies of two animals, in these opposite conditions, and ascertaining its strength by appending weights to it: the muscle taken from the healthy animal, or that in a state of *tone*, will sustain a much greater weight than that which is in the opposite state. Thence, to a certain extent, *tone* implies a difference in the mechanical condition

* From the Greek word *τὸνος*, tension.

of muscles ; a greater degree of density and cohesion of their component fibres ; but this must be also joined with *elasticity*, that is, the power of resisting extension, and of restoring itself when the extending cause is removed, before the part can be said to be in the state of perfect tone. That this state is truly the result of vital energy, is evident ; for the same muscle loses the power of sustaining the weight which it supported when first cut from the body, and this in proportion to the distance of time from that of its separation from the living body.

Medicines, or medicinal agents which produce this state of healthful tone, and renew the *tension* and vigour of the muscular fibre, are thence denominated *Tonics*. They act on the vital principle through the medium of the nerves ; and, as far as their mode of operating is understood, we may regard them as excitants. But it has been mentioned, that the excitement which is the result of the action of excitants is always followed by proportional languor or collapse : how, then, it may be reasonably enquired, can those substances which produce a *permanent* effect on the vital energy be regarded as excitants ? Are we to suppose that the difference caused by general excitants, when they produce a tonic effect, depends on a state of the parts ? If not, to what are we to attribute this diversity of effect from causes which are similar ? It is difficult to reply to these questions ; and we can only affirm, that there appears to be something in the nature of the stimulus, which regulates both the extent and the energy of its action ; and, according to the degree of its powers in these respects, the effect which it produces is more or less transitory. If the nature of the medicine or agent be such as to induce a *sudden* and *high* state of excitement, it is as quickly followed by collapse ; and the changes resulting in both states are sufficiently obvious. The agent in this case is a simple *excitant*. But when the nature of the medicine is such that the excitement is slowly produced, and the consequent exhaustion scarcely obvious, and, if the stimulus be renewed before this is complete, the impression becomes, in a certain degree, permanent ; for the habit which the reiteration of the stimulus induces is less powerfully felt ; and,

consequently, there is a gradual abatement of exhaustion ; while, at the same time, the increased vigour, which is the result of the action induced, becomes permanent. The agent thus operates as a *Tonic*. Still we must admit that there is merely a modification of the same action in both these cases : if the dose of the stimulant be so reduced that the effect produced is slight, and it be repeated at short intervals, the ultimate effect will be tonic : on the contrary, if the administration of the tonic be carried to excess, it will exhaust the powers of the system ; and, if administered in a state of excitement, its effects will be as injurious as those of a direct stimulant. We are, therefore, authorized in regarding Tonics as excitants, permanent in their effects, because gradual and moderate in their operation.

But it may be argued, that, according to this definition, any substance which restores the strength and vigour of the body when it is weakened and relaxed, is to be regarded as a tonic. Now it is undeniable that a state of relaxation and debility may depend on loaded states of the stomach and intestines, which can be remedied by the action of an emetic or that of a purgative ; and, thence, the salutary change which these agents produce, by the removal of the debilitating causes, is equivalent to the action of a tonic ; but, certainly, these medicines cannot be regarded as *tonics*. It might with equal truth be asserted that every medicine within the range of excitants produces a relative tonic effect on the habit ; but those agents only are to be considered *tonics*, the invigorating effects of which are not relative, but the direct sequence of their administration.

Having thus, I trust, satisfactorily explained the nature of Tonics, let us now enquire in what manner their effect is extended to the whole system, when their primary impression must be necessarily local.

Tonic agents may be both mental and material. With regard to the first, mental agents, experience has demonstrated that *Confidence* and *Hope* are powerful Tonics. Two physicians employing the same remedies, and in every respect adopting the same line of treatment in the management of a disease, would not be equally successful, if the patient

reposed a greater degree of confidence in one of them than in the other. Every practitioner who has had many years' experience, and has not shut his eyes to the effects of mental impressions on the recovery of his patients, knows well the paramount importance of this agent in the treatment of diseases, and the great advantages derived by gaining this ascendancy over the mind of a patient.

How does Confidence operate? I reply, that the general impulse which the exhilaration of mind consequent on the Confidence inspired in a patient, stimulating the heart to vigorous action, diffuses the blood more equally over the system, throwing it into the capillaries, and thus restoring the general balance of the circulation. With the increased vigour of the arterial action, the discerning system must, necessarily, sympathize; and, consequently, every function be properly fulfilled; a certain determination of blood to every part of the body being absolutely requisite for the support and continuance of all its functions. Even during the existence of diseased states of the habit, such as hæmorrhages, which threaten its immediate dissolution, courage and confidence will sustain the action of the heart, and avert that syncope which would otherwise take place: for when the afflux of blood to the brain is diminished, the usual stimulus of distension is removed; thence a loss of sense and of voluntary motion supervenes, and, if this continue to a certain extent, immediate death is the consequence.

In the same manner, Hope operates as a powerful Tonic. Deprive a patient of this solace, even after his disease is removed, and debility alone remains: there can be no solid assurance of his recovery to perfect health; inspire him with the hope that his recovery is certain, and the prognostic will seldom fail to be realized.

If these observations be correct, if animating passions operate as tonic powers upon the animal frame, depressed and debilitated by disease, we must ascribe their influence to the connection of the mind with the body, through the medium of the nerves; and if a tonic effect be the result of nervous energy in one case, there is no reason why it should not be referred

to the same cause when material agents are employed. Let us trace the operation of Tonics upon the different organs of the body.

1. *Action of Tonics upon the Muscular System.*—Tonics act upon the muscular system through the nerves; for every muscle is amply furnished with blood vessels and nerves both of motion and of sensibility. It is true that the nervous threads do not appear “in invisibilem pulpam deliquescere,” as Blumenbach expresses himself, and then to unite intimately with the muscular fibres: nevertheless, any stimulant, acting, even mechanically, on the muscle, must act at the same moment upon the nervous energy; and the discoveries of Sir C. Bell have satisfactorily convinced us that no motion occurs in the human body, at least, without the medium of one set of nerves; and that there is no necessity for the existence of sensibility to prove the presence of nerves. The change which is effected, therefore, upon one set of muscles extends to the rest, all being more or less united by that connection which depends on the communication by nervous sympathy. It is upon the strength, or tension only of the muscle that a tonic acts; the contractile power and mobility of the muscular fibres are not increased; thence the employment of Tonics renders a man stronger, but not more active.

2.—*upon the Digestive Organs.*—When a vegetable Tonic is taken into the stomach, it is first partially digested, and the active matter is thus separated from the inert. The active then exerts its action upon the mucous membrane of the stomach, and the bundles of muscular fibres beneath it suffer contraction: the same circumstance occurs through the whole length of the intestinal canal; the coats become firmer and more resisting, whilst the cavity of the intestine is contracted. The primary action, therefore, is upon the stomach and alimentary canal; but a secondary follows upon the rest of the system. It is scarcely possible to refer the extension of the tonic power to any thing but nervous energy; for, although some of the Metallic Tonics are absorbed and carried into the circulation, yet, many of the Vegetable Tonics produce their effects so rapidly after they are taken into the stomach, that there is no

time to permit their being carried into the blood ; nor have any portion of them ever been discovered, by any chemical test, in that fluid.

It is not my province to explain the nature of sympathy. By nervous communication, I do not mean to imply direct nervous connection ; for it would appear, from an experiment of Bichat, that the sympathy of animal contractility never takes place unless the nerves connecting the affected muscles with the sensorium be entire : when they are divided, the contractions in the corresponding muscles cease. In whatever manner it is effected, it is by sympathy alone that we can explain the manner in which Tonics, acting primarily upon the stomach, produce their effects upon the rest of the system.

If the stomach be suffering from disease, the action of Tonics produces effects which require to be noticed. Thus, if the organ be in a state of hypertrophy, tonic medicines augment the already too great appetite ; they add to the rapidity of the digestive function, and they accelerate the return of hunger, which is already so imperious. When the stomach is suffering from softening or relaxation of its coats, a salutary effect follows the administration of Tonics ; the appetite is awakened, and chymification is favoured. When simple irritation exists, Tonics increase the evil : this is manifested by a red, dry tongue, and thirst, pain and fulness of the epigastrium, anxiety, and a strong desire for acidulous and cold fluids. If ulceration of the stomach exist, and this at the cardiac portion, little effect is produced by a Tonic ; but if it exist at the pylorus, or the great curvature of the organ, the impression of the Tonic is made evident by a sensation of heat and pain which cannot be mistaken. Thus, in cancer of the organ, if ulceration have commenced, Tonics cause great uneasiness, morbid secretions, vomitings, heat, and severe lancinating pains. A knowledge of these facts is highly important in a practical point of view.

As appetite and digestion are promoted by the operation of Tonics on the stomach itself, it may appear singular that their frequent and long-continued use is generally followed by a loss of tone ; but such is really the case.

3.—*upon the Circulating and Respiratory Organs.*—Tonics

act upon the heart through its sympathy with the stomach, and also by the absorption of the active principles of the substances employed, so that they can be directly applied to the moving centre and to the coats of the blood vessels, and thus increase their muscular energy. After the administration of a full dose of a tonic medicine, the pulse is fuller and firmer ; but the current of the blood is not accelerated. The Tonic strengthens the organs, without precipitating their action. This influence of tonics is extended to the capillary system.

In a healthy state of the lungs, no appreciable effect on those organs follows the employment of Tonics : but under disease their influence is rapidly made conspicuous. In an irritable state of the lungs, they excite cough, a sensation of heat in the chest, and a feeling of anxiety. In an inflammatory state either of the substance or the membranes of the lungs, the intensity of the symptoms is increased, the cough is augmented, and the expectoration suppressed. On the other hand, when the lungs have suffered from previous severe disease, when all excitement is over, then Tonics lessen the force and the frequency of the cough, and promotes expectoration.

4.—*upon the Secerning System.*—It is chiefly upon the renal and subcutaneous glands that Tonics exert any influence ; but, in adding strength to those organs, they do not increase their secreting powers : the action of the glands is maintained in that state which they preserve in health. Tonics produce no marked action on the urinary organs in a state of health ; but, in disease, they invigorate the kidneys and secure their ordinary operation. In an irritable state of the kidneys, Tonics add to the mischief ; but, in a leucophlegmatic condition, Tonics increase the urinary discharge ; they enter the circulation, and augment the vitality of the kidneys. They also increase the energy of the cutaneous capillaries ; and consequently are indicated in cases of great debility accompanied with profuse sweating.

5.—*upon the Nervous System.*—From what has been already said, the influence of this class of medicines upon the nerves may be readily understood. It is, therefore, unnecessary to enter more particularly into this part of our enquiry.

The effects of Tonics upon the system are seldom rapidly

apparent; but, after they have been taken for some time, their influence becomes apparent, by the increased force of the circulation, the augmented power of the digestive organs, the improvement in the secretions, the abatement of nervous susceptibility, and the increased power, in particular, which is communicated to the muscular system. The effect of a Tonic, when it operates favorably, is, in fact, to place the system in that state which characterizes health; and, from the mode in which it operates to produce this effect, the character of the diseases in which Tonics are indicated is sufficiently obvious: they are evidently those of depressed power. But the chief use of Tonics, as medicinal agents, is in convalescence, when the habit has been left weak and greatly relaxed after the attacks of acute diseases. In this state, the gentlest Tonics, in combination with aromatics, are to be preferred. This combination is, in many vegetable substances, found to be effected by the hand of Nature; and those plants which exhibit a bitter principle in conjunction with a volatile oil are the best adapted for producing a tonic effect, in cases such as those to which I have alluded.

Bitterness is a quality of almost all the vegetable Tonics, and indeed has been regarded as essential to Tonics; but those vegetable substances which are purely bitter, such as quassia, scarcely affect the force of the circulation, and require the addition of aromatics. Aromatics operate in too transitory a manner, in general, and stimulate too powerfully, to be employed alone; but, in combination, they aid the effect of bitters: and it is a curious fact, that the most powerful vegetable Tonics generally contain these two qualities conjoined. The aromatic principle, generally, resides in an essential or volatile oil; and, consequently, *decoction*, as it dissipates this oil, is an improper form of preparation for aromatic Tonics.

It is probable, as I have said, that part of all the vegetable Tonics are digested in the stomach; and the principle, whatever it is, which produces their tonic influence, is thus separated from the other parts; and, consequently, it is enabled to act with more energy upon the nerves of the stomach. Dr. Chapman, and, following him, Dr. Paris, attempt to prove that bitterness is essential to all Tonics; or, in other words,

is the *tonic* principle: Dr. Paris also maintains that bitter extractive seems to be as essential to the digestion of the herbivorous as salt is to that of carnivorous animals: a singular comparison; as salt is, in one form or another, as essential to *herbivorous* as to *carnivorous* animals. It is true that bitter extractive is a natural stimulus, which is itself not decomposed in the stomach, and passes through the whole course of the intestinal canal unaltered: but there are even vegetable Tonics that contain little or none of this principle, and the tonic power of which is nevertheless very considerable. The tonic effect of bitters is well known; they aid digestion, and enable substances—such, for example, as gums—to be acted upon by the stomach; which, without it, would pass through the bowels very little changed. But, although bitter extractive is a powerful Tonic, and produces its primary action on the stomach, yet, it by no means follows that its presence is essential in all vegetable Tonics; nor is it, in my opinion, by any means a tenable position, that even nitrate of silver is indebted to the bitterness which distinguishes it for the tonic power which it possesses, as the justly distinguished author of the *Pharmacologia* has ventured to assert.

It does not appear to me requisite to regard bitterness, or any single principle, as alone productive of *tone*; and this opinion is confirmed by the experiments of Dr. Crawford, who ascertained this curious fact—that “the property of strengthening the intestines, and of weakening the skin, is common to all the substances justly celebrated for the cure of intermittent fevers.” This property, he found, belongs to *ipecacuanha*, to *emetic tartar*, *muriate of ammonia*, *gentian root*, *chamomile flowers*, and to *Peruvian bark*. And it is remarkable, that the latter substance, or its salts, the most efficacious remedies hitherto discovered for intermittent fever, possesses the above-mentioned property in the highest degree. These facts are not mentioned as applicable to any practical purpose, but merely as giving force to the remark that no single principle can be regarded as solely productive of *tone*.

TABLE OF TONICS.

A. TONICS ACTING PRIMARILY ON THE STOMACH.

* *Organic Products.*

a. CINCHONIA—

*combined with Kinic Acid, in**Cinchona lancifolia.* 5. 1. Cinchonaceæ.———— *oblongifolia.* — — —————*combined with Igausuric Acid, in**Cusparia febrifuga.* 5. 1. Rutaceæ.*combined with Sulphuric Acid, in**Sulphate of Cinchonia.*

b. QUINIA—

*combined with Kinic Acid, in**Cinchona cordifolia.* 5. 1. Cinchonaceæ.———— *oblongifolia.* — — —————*combined with Sulphuric Acid, in**Sulphate of Quinia.*

c. PIPERINA—

*combined with Acrid Oil, in**Piper nigrum.* 2. 3. Piperaceæ.———— *longum.* — — —————*Anthemis nobilis.* 19. 2. Compositæ.

d. GENTIANIA—contained in

Gentiana lutea. 5. 2. Gentianeæ.———— *Chirayita.* — — —————

e. SALICINA—contained in

Salix fragilis. 22. 2. Amentaceæ.———— *Caprea.* — — ————————— *alba.* — — —————

f. QUASSINA—contained in

Quassia excelsa. 10. 1. Simarubaceæ.———— *Simaruba.* — — —————*Chironia centaurium.* 5. 1. Gentianeæ.

g. BITTER EXTRACTIVE—contained in the

Roots — *Cocculus palmatum.* 20. 6. Sarmentaceæ.*Geum urbanum.* 12. 5. Rosaceæ.

- Plant — *Cetraria Islandica*. 24. 3. Lichenes.
 Leaves — *Menyanthes trifoliata*. 5. 1. Gentianeæ.
 Arbutus Uvæ Ursi. 10. 1. Ericææ.
 Flowers — *Cnicus benedictus*. 19. 3. Compositæ.
- h. VOLATILE OIL—contained in
 Croton Cascarilla. 21. 8. Euphorbiaceæ.
 Acorus Calamus. 6. 1. Aroideæ.
 Myrrh.
- * * *Inorganic Substances.*
- i. OXIDES OF METALS (*simple Radicals with Oxygen*).
 Lime.
 Oxide of Zinc.
- k. ARSENIC—
 combined with Oxygen, in
 Arsenious Acid.
- l. METALLIC SALTS (*Oxides with Acids*).
 Arsenite of Potassa.
 Sulphate of Zinc.
 Acetate of Zinc.
 Sulphate of Copper.
 Acetate of Copper.
 Subnitrate of Bismuth.
 Muriate of Baryta.

B. TONICS ACTING THROUGH THE MEDIUM OF THE BLOOD.

- m. OXIDES OF METALS.
 Black Oxide of Iron.
- n. SULPHUR—
 combined with Oxygen, in
 Sulphuric Acid.
- o. NITROGEN—
 combined with Oxygen, in
 Nitric Acid.
- p. METALLIC SALTS.
 Muriate of Lime.
 Chlorate of Potassa.
 Nitrate of Silver.

Sulphate of Iron.
 Hydrochlorate of Iron.
 Carbonate of Iron.
 Acetate of Iron.
 Tartrate of Iron and Potassa.

g. CHLORINE—

combined with a Metal, in
 Chloride of Sodium.
 ——— of Calcium.
combined with Hydrogen, in
 Muriatic Acid.

C. TONICS ACTING SOLELY ON THE NERVOUS
 SYSTEM.

* *Material.*

Cold Bathing.
 Exercise.
 Friction.

* * *Mental.*

Hope.
 Confidence.
 Travelling.
 Amusement.

VEGETABLE PRODUCTS WHICH OPERATE AS TONICS.

a. CINCHONIA.—This is an alkaline salt, crystallized in white, transparent, needleform crystals when pure. It is inodorous and bitter to the taste, nearly insoluble in cold water, and requiring 2500 times its weight of boiling water for solution. It is soluble in alcohol, and slightly so in ether and in fixed and volatile oils. It is unalterable in the air ; it displays an alkaline reaction with the blue of vegetable colours reddened by acids ; unites with many acids, and forms neutral salts. When submitted to a high temperature, Cinchonia is decomposed, affording the usual products of azotized substances : its ultimate components are—

	Pelletier and Dumas.	Brandes.	Henry and Plisson.
Carbon	76.97	79.90	78.88
Azote	9.04	13.72	9.35
Hydrogen	6.12	7.17	8.87
Oxygen	7.97	0.00	2.89

Owing to the little solubility of Cinchonia, it exerts scarcely any action on the animal system: but, in combination with acids, it forms a very valuable Tonic.

Cinchonia is procured by boiling a pound of powdered Pale Bark in a gallon of water, acidulated with f3iii of sulphuric acid, and re-boiling the residue in fresh portions of acidulated water until it cease to yield any thing to the water. These decoctions are next to be evaporated and mixed with newly slackened quick-lime, which, forming an insoluble salt with the acid, carries down with it the Cinchonia. This sulphate of lime and Cinchonia is then dried, and treated with boiling alcohol, which takes up the Cinchonia; and, by evaporation, the salt is obtained in a chrySTALLINE form.

Cinchonia is the active principle in several of the officinal Barks, in which it is combined, either with *Kinic acid*, forming a kinate, or with *Igausuric acid*, forming an igausuriate.

Kinic acid has an acid taste, and reddens the tincture of litmus. Its crystals resemble those of tartaric acid, and are unalterable in the air. Kinic acid is soluble in water, from which it is precipitated by the nitrates of silver, mercury, and lead. When heated, it is partially decomposed, and converted into a distinct acid, which is characterized by precipitating persalts of iron of a beautiful green; and has been named Pyro-kinic acid. It forms kinates with salifiable bases, and is contained, in combination with Cinchonia, in the bark of *Cinchona lancifolia*, and *Cinchona oblongifolia*. This acid possesses no medicinal properties. I shall afterwards notice the properties of Igausuric Acid.

Cinchonia, when separated from the kinic acid and combined with sulphuric acid, is very soluble, and eminently displays tonic effects.

The *sulphate of Cinchonia* is readily formed by the direct union of the acid and pure Cinchonia. It crystallizes in short, truncated prisms, sometimes single and irregular, some-

times double. This salt is soluble in $6\frac{1}{2}$ parts of alcohol, of sp. gr. 817° , and $11\frac{1}{2}$ parts of absolute alcohol: it requires 54 parts of water at 65° for its solution. By adding sulphuric acid to a solution of this sulphate and evaporating, a bisulphate is obtained, colourless, permanent in common air, in octohedral rhomboids, soluble in half their weight of water, and in their own weight of alcohol at 817° . The composition of the neutral sulphate is:

	Dry.	Crystallized.
Cinchonia	88.636	84.324
Sulphuric Acid	11.364	10.811
Water	— —	4.865
	<u>100.000</u>	<u>100.000</u>

That of the bisulphate:

Cinchonia	79.592	67.241
Sulphuric Acid	20.408	17.241
Water	— —	15.518
	<u>100.000</u>	<u>100.000</u>

Sulphate of Cinchonia has been little used, owing to the superior power of the sulphate of quinia, formed from an alkali found in Yellow Bark. The solutions of sulphate of Cinchonia are decomposed and precipitated by infusion of galls, and all vegetable infusions containing the gallic acid.

As the Cinchonia is contained in the Bark in the form of a kinate, it might be supposed that this salt would be the best substitute for the Bark. This conclusion, however, is more specious, probably, than true: for the artificial combinations of the active principles of the vegetable kingdom frequently produce more useful compounds than the natural. The kinate, however, may be separated in the following manner:

Evaporate a strong decoction of Pale Bark to the consistence of a syrup; then pour upon it three times the quantity of cold water originally used, and separate the deposit. Evaporate the liquid to one half, and saturate the excess of kinate acid with subcarbonate of lime; then add newly prepared hydrate of oxide of lead; and, when the whole has become of a clear yellow colour and neutral, filter. Pass through the filtered liquor a stream of sulphuretted hydrogen, and, having again filtered, evaporate to the consistence

of a syrup: treat this with alcohol at 815°, which throws down the kinate of lime and gum, and also a certain quantity of the kinate of Cinchonia. Solution in water and crystallization afford the salt in the crystalline state. This kinate is soluble in water, but scarcely in alcohol at 815°, is very bitter, and is decomposed by ammonia and lime water. An artificial kinate may be prepared by combining the Cinchonia already prepared with kinic acid: a clear, very bitter, scarcely acid solution is obtained, which, when evaporated in a water bath, furnishes an amber-coloured mass, or, if slowly crystallized, bright papillary crystals.

The medicinal effects of the pure kinates are not yet determined, but are well deserving of examination.

1. CINCHONÆ LANCIFOLIÆ CORTEX, L. E. D.—This is the Pale Bark of the shops. It is the first of the barks of this important genus which was brought to Europe by Condamine, and thence has been named Condaminea by Humboldt and Bonpland. The Bark is called Crown Bark in commerce.

The genus *Cinchona* belongs to the natural order Cinchonaceæ. It is a very extensive genus, but, as yet, little known. The greater number of the species are natives of South America, particularly of Peru, and to the west of the Andes. A few species have been found in Brazil; one species, the *Cinchona excelsa*, in the East Indies, in the mountains of the Circars.

The Cinchonas are generally barked in September; and the bark is known to be in a proper state when, on raising a portion of it, the air gives it a reddish colour. The younger the branch is, the more it is quilled: but the desire for quilled bark causes the collectors sometimes to quill it by heat.

This species of *Cinchona* is found chiefly in Peru, growing at heights of from 6,250 to 8,300 feet, at a mean temperature between 59° and 62° Faht. It is a lofty, handsome *evergreen* tree, rising from 30 to 40 feet high, and seldom found in groups*. Although the bark which this tree yields is the original Pale Bark, yet there is reason for thinking that each seronne or package contains the bark of several distinct

* London Dispensatory, art. *Cinchona*.

species. Thus, the *C. lancifolia*, *C. Nitida*, *C. hirsuta*, *C. glandulifera* of Ruiz, *C. Scrobiculata* of Humboldt, and the *C. glandulifera* of Ruiz and Pavon, also yield Pale Bark. It is generally rolled into small tubes or quills, covered with a rough, cracked epidermis, thickly beset with lichens; on which account it is called, in Peru, *Quinicana*, or hairy Quina. The lichens mark the quality of the bark—thus, those barks bearing *Hypochneus*, *Collemata*, and *Jungermania*, are bad: those bearing *Graphides*, or *Lecanoræ* are good. The quills vary from the size of a swan's quill to an inch and a half in diameter. Internally, the colour is a pallid fawn, or cinnamon hue, which is brightened to pale orange-brown when the bark is moistened. The smaller specimens break with a clean fracture, the larger with a fibrous. The quilled bark comes from Loxa; but those specimens which are not quilled, from Guanaco. On account of the quantity of lichens on this bark, the first powder should be rejected: indeed, the lichens should be scraped off before powdering the bark.

Pale Bark, besides being known in commerce by the name of *Crown Bark*, is called *Calysaya*, or *Callysalla*, to which the epithet descriptive of its species is added: thus, Quilled Bark is called *Calysaya* arrollada in cauntillos; flat, *Calysaya* de plancha; and so on. It is also known by the name *Cascarilla fina de Loxa**. There are four distinct varieties of Pale Bark.

1. The first is the *Quilled Bark of Loxa*, *Calysaya* ahumada de Loxa, *Cascarilla* de Loxa, in single and double quills, thin and light, in pieces of from twelve to eighteen inches long. Its epidermis is brown, or iron-grey, covered with *Graphides*: when it bears *Collemata*, it is bad. The taste of this variety is astringent and bitter, the odour weak. It is a rare bark.

2. A subvariety of this is the *Grey Bark of Loxa*, which is supposed to be the bark of the *Cinchona Hirsuta* of Ruiz and

* Other appellations are *Cascarilla naranjada* de Santa Fé, *Cascarilla* de Hojas Angustus,—poco rolludas,—rugosas,—lampina,—negra, and Palo Blanco. Under the appellation Quina, it is called Quina naranjada, Quina de Bagota, Quina negra de Loxa, Quina tunita, Quina fino; and under that of Quinquina, Q. Royal, Q. Royal batard, Q. orange de Perou.

Pavon. Its epidermis is smoother than the former variety, and is covered with a coating of whitish lichens, whence the colour which gives its name. It is thinner than the preceding variety ; indeed, almost as thin as Cinnamon Bark. The taste of this variety is astringent and bitter, with a faint aromatic odour. In Peru, it receives the name Lagartijada, Lizardlike, and Negrillo, Blackish, from the colour of its epidermis.

3. A third variety, the *Bark of Lima*, of which there are two subvarieties, both well known in commerce, one of which is the Grey Bark of Huanaco, probably the bark of the *Cinchona glandulifera* of Ruiz and Pavon, is in flatter, thicker, and coarser pieces than the Grey Loxa Bark, the quills being generally about an inch in diameter, the epidermis thin, easily separated, cracked with transverse fissures, and covered with stringy lichens. Its fracture is compact and ligneous, its colour internally yellow ; it has scarcely any odour, and tastes simply bitter and a little mealy. This is the variety of the Pale Bark most liked in this country.

4. *Havannah Bark*, of which I know nothing. The knowledge of these varieties is of little moment ; it is sufficient for the purposes of medicine to distinguish the Lima and the Loxa Bark, which may be easily done by the characteristics I have pointed out.

In tracing the chemical history of this species of *Cinchona* Bark, it is unnecessary to offer any account of the early analysis. Dr. Duncan, of Edinburgh, first hinted the existence of a new principle in *Cinchona*, from remarking, that the decoction is precipitated by infusion of gall-nuts ; and he named this principle *Cinchonin*. Gomez published, in the Memoirs of the Lisbon Academy, an examination of the *Cinchonin* of Duncan, which he procured by a particular process in small, white, acicular crystals. His process was to dissolve an alcoholic extract of *Cinchona* Bark in water, and then to treat it with potassa, which dissolved successively all the extractive, and left the *Cinchonin* undissolved. This was afterwards dissolved in alcohol, and crystallized by evaporation. The alkaline character of this salt was first pointed out and its properties investigated by Pelletier and Caventou.

Good Pale Bark, although it has scarcely any odour in substance, gives out an agreeable aromatic odour in decoction, which Dr. Irving ascertained to depend on a volatile oil, which he procured in a distinct state. The decoction is agreeably bitter, slightly acidulous and austere in taste, not unlike that of the petals of the *Rosa Gallica*. Both the infusion and decoction are of a pale, brownish-yellow colour: they redden litmus paper and precipitate tincture of galls, the gallic acid and tannin of the galls forming an insoluble tanno-gallate of *Cinchonia* by decomposing the kinate in the infusion of the bark. Both infusion and decoction render a solution of tartar emetic turbid, decomposing the tartar emetic, and rendering it inert; a circumstance which depends on the tannin of the infusion and decoction; as the solution of the pure *Cinchonia* does not precipitate the tartrate of antimony and potassa. The sulphate of iron produces a slight precipitate, of an olive green colour, evidently depending on the union of the kinic acid with the oxide of iron, of the sulphate, whilst the sulphuric acid unites with the *Cinchonia*, forming a soluble sulphate. The carbonates of the alkalies also throw down precipitates in the infusion and decoction of Pale Bark. The aqueous infusions of many bitter and astringent vegetables, as of Chamomile flowers, Calumba root, Cascarilla bark, horse radish, cloves, catechu, orange peel, foxglove, rhubarb, valerian, Simaruba bark, and Elm bark, precipitate the infusion and decoction of Pale *Cinchona* Bark. The tincture of this bark suffers similar decomposition from these reagents; but the colour struck in the tincture with sulphate of iron is deeper and blacker than that in the infusion. Muriate of baryta produces no change either in the decoction or in the tincture; both the muriate of *Cinchona* and the kinate of baryta, which result, being soluble: thence this salt may be administered in combination with infusion or decoction of Pale *Cinchona* Bark. The quantity of the precipitate formed with the infusion of gall-nuts demonstrates the goodness of the bark; for, according to the quantity of *Cinchonia* which it contains, the tanno-gallate will be more or less abundant. All the other precipitates may occur, although no *Cinchonia* be present in the

infusion or decoction. According to the analysis of Pelletier and Caventou, the bark of this species of *Cinchona* contains—kinate of Cinchonia; a green fatty matter; a red colouring matter, scarcely soluble, which may be converted into tannin by the alternate action of alkalies and acids; a red soluble colouring matter, tannin; a yellow colouring matter, precipitable by acetate of lead; kinat of lime; gum; starch, and woody fibre*.

When cold water is poured into a decoction of pale *Cinchona* bark, the red colouring, scarcely soluble matter is copiously precipitated. When this precipitate is dried and pulverized, it is of a dull red colour, and its bitterness is slowly perceived on the palate. It is a compound of tannin and kinat of Cinchonia; and it is this substance that decomposes the solution of Tartar emetic, when it is added to infusion of Bark, forming an insoluble tannate of antimony.

The pharmaceutical preparations of the Pale Bark are infusion and decoction. They should always be made with water acidulated with diluted sulphuric acid, which, changing the kinat of Cinchonia to a sulphate, renders the Cinchonia infinitely more soluble. The use of these preparations is becoming daily less common since the introduction of the sulphate of *Cinchonia*. The evaporation of the decoction forms the watery extract, in which the kinat of Cinchonia is combined with all the other components of the Bark except the woody fibre. It is now scarcely ever employed. There are three tinctures of Pale Bark ordered in the British Pharmacopœias:—1. A simple alcoholic solution of the kinat of Cinchonia, the colouring matter, and the tannin: it is prepared by macerating the powdered Bark in proof-spirit. 2. A tincture made with aromatic spirit of ammonia—the *Tinctura Cinchonæ Ammoniata*—but it is at least a doubtful preparation, in as much as the Cinchonia is thrown down by the ammonia. 3. A compound tincture containing several aromatics, such as orange peel, Virginian snake-root, and saffron, which add to the power of the kinat of Cinchonia. The cochineal is a useless ingredient.

Cinchonia is also found in another Bark which does not be-

* Journal de Pharmacie, tome vii.

long to the genus *Cinchona*; but, in this case, it is not combined with kinic acid.

2. CUSPARIA CORTEX. L. E. D.—This bark, which was first brought to Europe in 1788, is the production of the *Cusparia febrifuga* of Humboldt, the *Bonplandia trifoliata* of Willdenow*, and which St. Hilaire supposed is a species of *Galipea*. It is a handsome tree, a native of South America, belonging to the natural order Rutaceæ. Cusparia Bark is in pieces from six to twelve inches in length: it is sometimes quilled. The epidermis is whitish, unequal, rough, the interior of a fawn colour, hard, firm, breaking with a resinous fracture, and, when, pulverized, giving a powder of a yellowish-brown hue, which, triturated with magnesia, exhales ammonia. If the bark be chewed and retained for some time in the mouth, it is bitter and aromatic; but it leaves on the palate an *astringent, nauseous* taste. Both cold and hot water take up its active principles; and alcohol dissolves the bitter and aromatic. The tincture is decomposed by water: proof spirit is its menstruum.

The aqueous infusion and decoction of Cusparia Bark is precipitated in the same manner as that of the *Cinchona* Bark by infusion of gall-nuts and other astringent vegetable infusions and decoctions; but neither by solution of gelatin nor tartar emetic. It is also precipitated by the sulphates of iron and those of copper and of zinc. The nitrate of silver throws down a copious white precipitate, which gradually becomes of a dull purple hue on being exposed for some time to the light; affording a presumption that the ammonia which this Bark contains is in the state of a muriate. With the salts of lead, bichloride of mercury, the carbonates of potassa and soda, muriate of baryta, and lime water, precipitates are produced, which demonstrate that the *Cinchonia* is not in the state of a kinate in Cusparia, as both the muriate of *Cinchonia* and the kinate of baryta are soluble salts. Ammoniated sulphate of copper produces a pea-green precipitate. Nitric acid deepens the colour of the infusion nearly to a blood-red, and, after some time, causes a precipitate of a

* Woodville's Med. Bot. third edition, vol. v, p. 120. London Dispensatory, art. Cusparia. Trans. of the Medico-Bot. Soc. of London, vol. i, part i, p. 17.

lemon-yellow colour. Muriatic acid causes no precipitate; but, after it is added to this mixture, a solution of the ferrocyanate of potassa throws down a copious yellow precipitate. Sulphuric acid produces no effect on the infusion of Cusparia Bark. If the powdered Bark be digested with sulphuric ether, and the fluid evaporated on the surface of water, a thin pellicle of pure resin is left. From these facts, we may conclude that the chief components of this Bark are *Cinchonia*, a trace of *brucia*, *muriate of ammonia*, *gum*, *resin*, and *extractive*; that it displays no traces of either tannin or gallic acid; and that the acid with which the Cinchonia is united is the *igausuric*. Its odour depends on an acrid essential oil, which can be procured in a separate state by distillation.

This bark was first brought to this country in 1788; and, as the plant from which it was procured was then unknown, it was named Augustura Bark, from the Spanish appellation *Corteza del Augustura*; Augustura being the vulgar name of the town of St. Thomas, the place of its export. The native name of the tree is *Cuspare*; thence the appellation *Cusparia*. When the bark is good, the lichens which mark its qualities are the same as those of the lanceleaved Cinchona; but one which is named *Myriotrema* is peculiar to the Cusparia, and always distinguishes the true from the false Cusparia, which is frequently mixed with the true. This Bark was supposed to be that of the *Brucea ferruginea*, or *dysenterica*, a plant belonging to the natural order Xanthoxyleæ, a native of Africa: but this is an error; and the plant yielding the *false Cusparia Bark*, as it is termed, is still unknown, although it is suspected to be a species of *Strychnos*. It is in longer pieces than the true Cusparia Bark; is more or less quilled, compact, and breaks with a brittle, mealy fracture; but it is less fragile than the true Cusparia. The epidermis is covered with distinct, rust-coloured, warty excrescences. Its powder is a lighter yellow than that of the true Bark: it has none of the odour of the real Cusparia: it impresses no aromatic flavour on the palate, nor any taste but the most disgusting, durable bitter, without the acrimony of true Cusparia. It is distinguished from the true Bark chiefly by the effects of the

following reagents on its infusion : 1. Carbonate of potassa deepens the red colour of the infusion of the true Bark, and gradually deposits a clear citron-yellow, flocculent precipitate : in the infusion of the false Bark, the precipitate is greyish-yellow, and the supernatant fluid becomes dark-brown, beginning at the surface. 2. Persulphate of iron causes a dark precipitate, changing, by degrees, to a satin-black, verging to an ash-grey in the infusion of false Cusparia. 3. Water, acidulated with muriatic acid, shaken with the powder of false Cusparia, takes a beautiful, clear green colour when an alkaline prussiate is poured on it, and in a short time it deposits prussiate of iron ; which does not occur when the true Cusparia is thus treated. 4. The bark of false Cusparia contains much brucia—a very poisonous alkaloid which strikes a deep crimson colour with nitric acid. Brucia causes the sensation of stinging by ants over the skin, and slight tetanic convulsions. In its separate state it has been employed as a remedy in cases of paralysis by two French physicians, M. Lherminier and the younger M. Andral : but it is both less poisonous and less active as a medicine than strychnia.

As a medicinal agent, the Cusparia Bark possesses all the tonic properties of Cinchona ; and, from containing a larger proportion of acrid volatile oil, it is more directly stimulant. It was originally introduced for the cure of intermittent fevers, and was so much lauded, that it was supposed likely to supersede the use of the Cinchona Bark ; but, in this respect, its powers were greatly overrated. It is, nevertheless, an excellent aromatic tonic in convalescence from fevers, dysentery, and diarrhœa ; and, whilst it increases the appetite and restores tone, it never oppresses the stomach. In dysentery, however, much caution is required not to prescribe Cusparia until the inflammatory stage of the disease is fairly subdued : as the acrimony of its essential oil renders it injurious in every instance of disease connected with inflammation of the mucous membrane of the intestinal canal. In those cases of dyspepsia which admit of the use of Tonics, the Cusparia Bark, owing to the combination of an aromatic with its tonic principle, is to be preferred to all others ; it requires no tincture to warm it ; an addition which, in my opinion, is

always to be avoided in dyspeptic affections, unless the general strength be greatly reduced, and the pulse indicate a sinking state of the habit.

The best form of administering Cusparia Bark is in powder, combined with rhubarb; or, in hypochondriacal affections, in which the extrication of ammonia is useful, with magnesia. The dose is from gr. v. to ℥i. It is also exhibited in the form of infusion and of tincture. The reagents that precipitate the infusion are incompatible in prescriptions with it. In large doses it nauseates, probably owing to the brucia which it contains.

QUINIA.—This is an alkaline salt, first procured by M.M. Pelletier and Caventou, from the bark of the *Cinchona Cordifolia*, the Yellow Bark of the shops; in which it exists as a kinate, in conjunction with a small quantity of kinate of Cinchonina. It is a white, friable, incrustable salt, which, if exposed to heat, melts into a resinous-like substance. It is more bitter than Cinchonina; is scarcely soluble in water, but soluble in alcohol and ether; and, in conjunction with acids, furnishes neutral salts: the best known of which is the sulphate.

Quinia may be combined with two proportions of sulphuric acid; one forming a salt which is perfectly neutral, the other an acidulous salt. The first, the neutral salt, that in common use, is pure white, in silky needles, little soluble in cold water, more soluble in boiling water, and completely so in water acidulated with sulphuric acid. It is also very soluble in alcohol. It effloresces in the air, losing $\frac{3}{4}$ of its weight; is phosphorescent in a temperature of 210° Faht.; and is decomposed by all substances that form salts with sulphuric acid. It is readily distinguished from sulphate of Cinchonina by the form of its crystals, those of the salt of Cinchonina being lamellar. It is soluble in 74 parts of water, at 60°, and 30 parts of boiling water.

The acidulous or bisulphate is in larger needle-form quadrangular crystals. The components of these salts are—

NEUTRAL SULPHATE.

	Crystallized.	Effloresced.
Quinia . . .	80.9	90.000
Sulphuric acid .	10.0	10.000
Water . . .	9.1	—
	<u>100.0</u>	<u>100.000</u>

ACIDULOUS SULPHATE.

Quinia . . .	63.5	81.819
Sulphuric acid .	19.1	18.181
Water. . .	<u>17.4</u>	<u>—</u>
	100.0	100.000

The bisulphate is soluble in eleven parts of water, at 60°, and at a temperature of 212° it dissolves in its own water of crystallization: and in diluted alcohol; but with difficulty in strong alcohol. It is colourless and permanent in the air; its crystals are rectangular, quadrangular prisms, sometimes compressed, sometimes square and truncated. Most commonly, however, the crystals are acicular. It would be better, were the acidulous sulphate used instead of the neutral sulphate, as it is very soluble; and the neutral sulphate is generally converted into it, in extemporaneous prescriptions, by the addition of sulphuric acid.

Sulphate of Quinia is sometimes adulterated. When the adulteration is white sugar, it is detected by digesting equal quantities of the suspected and the pure salt in the same quantity of distilled water to saturation. If the suspected sulphate be pure, each quantity will have the same sp. gr. and the same taste; and each portion should yield, by evaporation, equal quantities of solid residue: but if the suspected salt contain sugar, this will not be the case. If the adulteration be starch, a portion of the suspected salt will remain insoluble in cold water; and if the mixture be heated to 170° Faht. then cooled, and the tincture of iodine added, the starch will be made evident by the blue colour which iodine strikes with fecula. Boracic acid, with which it is also adulterated, is detected by dissolving the salt in alcohol and setting fire to the solution: if boracic acid be present, the flame will be green. A more difficult thing is to detect the sulphate

of lime, which is manufactured in acicular crystals, expressly for the purpose of adulterating the Sulphate of Quinia: it may, however, be detected by exposing the suspected salt to a red heat, in which the S. of Quinia will be decomposed, whilst the S. of Lime will merely lose its water of crystallization; and, when mixed with water, it will rapidly absorb the water and solidify in a few seconds. If the adulteration be an anhydrous sulphate of lime, it will remain insoluble in water, whilst the S. of Quinia dissolves.

If pure Quinia be rubbed in distilled water, one grain only will be dissolved for every 2500 grains of water present. In this state it is precipitated by solution of gall-nuts, and the bichloride and nitrate of mercury; but not by the salts of iron. Pure sulphate of Quinia is precipitated from its aqueous solution by acetate of lead; both the salts are decomposed; an insoluble sulphate of lead is formed, whilst an acetate of Quinia remains in solution. With the infusion of galls, an insoluble tanno-gallate of Quinia is thrown down: and, by lime-water, both the sulphate of lime and pure Quinia are precipitated. No change is produced by the salts of iron—a great advantage in the treatment of amenorrhœa in a debilitated habit. Acetic acid readily unites with Quinia, and forms a salt, which crystallizes in long, pearl-coloured needles, that are often grouped into stars: it is very soluble, and possesses the same medicinal powers as the sulphate.

CINCHONÆ CORDIFOLIÆ CORTEX. L.E.D.—The Yellow Bark is thicker than the Pale, less quilled, and more woody and fibrous. It is stated in the London Pharmacopœia to be the Bark of the *Cinchona Cordifolia* of Mutis; but it is probable that the Yellow Bark from Lima, the Quina Calysaya of the Spaniards, is probably not the produce of the *C. Cordifolia*; because the Quina de Santa-Fé, which is well known to be the bark of the *C. Cordifolia*, differs in appearance greatly from the former, which is the Yellow Bark of the shops. The Santa Fé Bark is known by the name of Hard Carthagena Bark. The *Cinchona Cordifolia* is a handsome tree, growing on the mountains of Loxa in Quito, and on those of Santa Fé, at a height of from 900 to 1440 toises.

This Bark is imported in chests, containing from ninety to

one hundred pounds each; and both quilled and flat pieces are contained in the same package. The flat pieces are generally devoid of epidermis; the quilled have a tawny, greyish-brown cuticle, covered with flat and stringy lichens; the thallus of which is so thickly extended over the Bark as almost completely to obscure the natural surface. There are two distinct varieties of Yellow Bark known in commerce. The *first* is in pieces of various sizes, from that of the finger to two or three inches in breadth. The smaller pieces have a thin epidermis, are very rugged, transversely cracked, and covered thickly with parasitic lichens. This Bark is of a yellow-fawn colour interiorly, very fibrous in the fracture, and possessing little astringency. The larger pieces have a thicker, rougher, and more deeply cracked epidermis; and, from age, the epidermis consists of various layers; but it is easily detached from the Bark, and is perfectly inert. The Bark is about two lines in thickness, of a deep fawn colour, and of a texture entirely fibrous; but fine and uniform. The fibres are studded with brilliant points, which appear to be the extremities of fibrils, which are detached with ease; they feel harsh between the teeth, and run into the fingers, occasioning itching. On breaking the bark, a fine yellow fibrous powder falls out. It tastes very bitter and astringent when properly freed from the epidermis. If the powder of Yellow Bark have a deep reddish-brown hue, it is certain that the epidermis has not been removed. The *second* variety is known in commerce by the name Orange Yellow Bark: it is less thick, more compact, and finer. This is the Bark of the *Cinchona Cordifolia* of Mutis. It occurs both in quills and in flat pieces. In the younger specimens, the internal part is of a pure yellow, the external of a rose colour: but this disappears in the old bark. The mixture of these two colours produces a tint which distinguishes this bark from every other. This bark is frequently in flat pieces, a little convex, and entirely devoid of epidermis.

Both varieties of the Yellow Bark have more bitterness, but less astringency, than the Pale Bark. They are more pulverulent, and the powder is of a brighter colour than that of the Pale Bark. The aqueous infusion and decoction

deposite, on cooling, a sediment, which is of a brighter colour than the dry powder. The infusion is less turbid than that of the Pale Bark: it reddens litmus paper and precipitates solution of galls; but more slowly than the infusion of the Pale Bark. Gelatin forms a pinkish-yellow precipitate; tartrate of antimony and potassa a yellowish-white and very copious precipitate; and the persulphate of iron throws down slowly a bluish-green precipitate. The other reagents which affect the Pale Bark act upon the Yellow.

Yellow Bark owes its tonic properties to the kinate of Quinia, which can be separated in the same manner as the kinate of Cinchonia is separated from the Pale Bark. The kinate in the natural Bark is intimately combined with a red, insoluble matter. When cold water is poured into a strong decoction of Yellow Bark, this red matter is thrown down; and, if magnesia be added, and the compound boiled with alcohol, Quinia, will be obtained. There is also a *red, soluble* matter which is procured by evaporating the decoction to the thickness of a syrup, then treating with cold water and filtering. According to Mutis and Zea, Yellow Bark is only indirectly febrifuge. The sulphate of Quinia is prepared by a process similar to that necessary for procuring the sulphate of Cinchonia. The kinate is first decomposed by boiling the powdered Bark with water acidulated with sulphuric acid: this is afterwards precipitated by lime, which, at the same time, carries down the Quinia coloured. This combination of sulphate of lime and Quinia is then dried, powdered, and digested in boiling alcohol, until no more soluble matter is taken up, which is known by the alcohol ceasing to acquire bitterness. The alcoholic solutions are then distilled nearly to dryness, to save the alcohol. The Quinia thus procured does not crystallize; and, if deprived of all humidity by drying, it forms merely a white, porous mass, little soluble in water, but very soluble both in alcohol and in ether. Like the Cinchonia, it displays alkaline properties, readily combines with acids, and forms with them crystallizable salts. In forming the sulphate, the residue of the alcoholic solution is treated with boiling water acidulated with sulphuric acid: the sulphate precipitates on cooling. The precipitated sulphate is

now to be dissolved in water and boiled with a small quantity of pure animal charcoal which has been well washed in muriatic acid: it is then to be filtered whilst it is hot. The crystals form as the solution cools: but, as they retain much water, they must be dried in a stove between folds of colourless blotting-paper. The chief point to be attended to in this operation is to see that the solutions are perfectly neutral, and well freed from colouring matter by the animal charcoal. The filtering papers should be kept from one operation to another, as much of the product is lost by using fresh filters.

According to the analysis of Pelletier and Caventou, Yellow Bark contains—an acidulous kinate of Quinia; a kinate of lime; a fatty matter; a red, insoluble, colouring matter which precipitates when the decoction cools; a red, soluble, colouring matter (tannin); a yellow colouring matter; starch; and lignin.

The knowledge of these constituents readily explains the result of reagents on the infusions, decoctions, and tincture of Yellow Bark.

We have already traced the existence of the two tonic salts, *Cinchonia* and *Quinia*, in distinct species of the Bark of the Cinchona, which are known in commerce under the names Pale and Yellow Bark; the Pale yielding *Cinchonia*, the Yellow *Quinia*, with a small proportion of *Cinchonia*, too small to give a character to the medical properties or the chemical nature of the Bark. In the Red Bark of the Pharmacopœias, these salts exist together in more equal proportions; and thus this Bark is not more distinguished by its colour and other physical properties than it is by its chemical constituents.

CINCHONÆ OBLONGIFOLIÆ CORTEX. L. E. D.—The British Pharmacopœias regard this species of Cinchona as that yielding the Red Bark. The *C. oblongifolia* grows in New Granada, near Maraquita, and yields a Bark known by the terms Quina de flor de Azahar, Cascarilla de Loxa, Cascarilla Azahar, and Cascarilla Maraquita de Loxa. The *C. magnifolia* of Ruiz and Pavon, which also yields Red Bark, is found in the Andes, and affords the Quina Amarilla of

the Spaniards, the Quina rouge de Santa Fé, and Quina rouge orange plât, of the French. Both kinds go by the name of Red Bark in this country. The last species is that best known. The first kind of Red Bark is known by the name of *smooth Red Bark*: the second kind is called *warty Red Bark*.

1. *The smooth Red Bark*, the Quina Roxa and colorada of commerce, is imported in chests, containing such a variety of pieces as to lead to the suspicion that the species yielding it are not accurately known. The pieces are both quilled and flat, seldom exceeding ten or twelve inches in length, of a lively red colour, fibrous, very hard, covered with a rough, often warty epidermis, transversely cracked, and not much covered with lichens. The cortical part is about a quarter of an inch in thickness, and breaks with a fibrous fracture. Immediately under the cuticle, there is a dark red, resinous matter deposited in the fibres, in the form of an agglomerated powder, which has a deeper colour than the rest of the bark.

2. *The Red Bark of Santa Fé* is in thick quills, nearly an inch in diameter, very rough on the exterior, cracked in different directions, and exhibiting deep fissures. Its epidermis is thin, adhering closely, and of a deep grey colour, spotted with yellow. The bark itself has a bright red colour, is brittle, and breaks with a fibrous fracture: when moistened, it has a peculiar, not agreeable, odour: is unpleasant in the mouth, although less bitter and acrid than the barks of the other species; but it is more acid, austere, and nauseous. This bark is essentially different from that which is found in the shops. The aqueous infusion of both kinds is of a ruby red hue, and lets fall, in cooling, a large quantity of insoluble red colouring matter, particularly if the decoction be concentrated and poured into a large quantity of cold water. It is more acidulous than the two former species; is slowly precipitated by the infusion of gall-nuts, and other infusions of bitter, astringent vegetables; and a very light, flocculent precipitate only is thrown down by gelatin. The protosulphate and persulphate of iron strike a deep bluish colour with little precipitate. It is also precipitated by tartar

emetic and perchloride of mercury. The tincture produces the same effect with these reagents as the infusion.

According to the analysis of Pelletier and Caventou, this bark contains—a large quantity of acidulous kinate of Cinchonia, and of acidulous kinate of Quinia; a red colouring matter; much tannin; a yellow colouring matter; a fatty matter; kinate of lime; starch; and lignin. From the effects of the decoction on the sulphates of iron, it is also probable that this species of bark contains traces of gallic acid, in combination with tannin. It is also, on this account, more astringent and stimulant than the other officinal species.

I have stated that there are evidently many varieties of bark in the same package. Formerly, this was of little importance: but, on account of the distinct salts contained in the different species, a knowledge of these has become necessary.

With regard to the medicinal history of Cinchona Bark, numerous fables have been propagated respecting the discovery of its medicinal virtues; but Baron Humboldt has ascertained that it was unknown to the Peruvians before the Spanish conquest. It was introduced into Europe in 1640, by the Countess of Cinchon, after whom the genus is named. A brief history of its various fortunes is contained in the London Dispensatory.

If a drachm of powdered Cinchona Bark, *pale, yellow, or red*, be swallowed, once in three or four hours, by a healthy person, it causes a dryness of the mouth, a sensation of weight and uneasiness at the stomach, an augmented force in the circulation of the blood, an increased flow of perspiration, a higher degree of temperature of the surface accompanied with redness, and a general excitement in every part of the frame. These symptoms demonstrate the stimulant power of the remedy; and, as these effects are permanent, we feel authorized to regard Cinchona as a *Tonic*, in reference to the body in a healthful state. With respect to its power in changing diseased into healthful action, and restoring the vigour and energy of the debilitated frame, every day's experience has proved its efficacy and that of its active principles in febrile diseases, especially those of an intermittent and remittent charac-

ter. Much was said, at one time, about the period of fever in which Cinchona Barks ought to be administered. Dr. Clarke of Newcastle, and others, gave it at every period and cured the disease: and Dr. Heberden, referring to this, in his Commentaries, remarks—"Unde didicimus suspicionem periculi a cortice, etiam sub ipsa febre adhibito, fuisse non minus vanam, quam multas alias suspiciones, quas nostri majores de utilissimo hoc remedio sparserunt." The remedial effects of the Barks depend on their alkaloids: their other principles exert either no energy, or a secondary influence only. Thus the kinic acid exerts a secondary influence by increasing the solubility of the Cinchonia and the Quinia. When these are separated, and united with mineral acids, as in the sulphates of Cinchonia and of Quinia, they are admirable Tonics. In their administration, we ought always to direct our attention to the state of the stomach and intestines before prescribing them; and not to administer them if these important organs be in an irritable condition.

Cinchona Bark, and its alkaloids in combination with acids, may be prescribed with great advantage in all diseases which assume an intermittent type, under whatever denomination they appear, whether as gout, rheumatism, the exanthemata, or eruptive fevers, catarrh, and even phthisis. Whenever a true intermittent character occurs, the Bark seldom fails to prove serviceable, and rarely or never injures. Even in local affections, this rule holds good. This is illustrated by a case recorded by Mr. Brodie. A gentleman, who had lived long in a tropical climate, became affected with stricture of the urethra, of a spasmodic nature, which recurred every alternate night about twelve o'clock, and continued until five or six o'clock in the morning. Mr. Brodie was consulted, and cured the disease, by anticipating the paroxysm and administering sulphate of Quinia in large doses at short intervals of time. In the intermittents of warm climates, Cinchona may be conjoined with calomel and aloes; and, even in this climate, the intestines should, in every instance, be kept rather in a lax state during the exhibition of Cinchona, or the sulphates of its alkaloids.

In many chronic diseases, although intermissions do not

occur, Cinchona Bark and its preparations are beneficially administered. Thus, in chronic pulmonary catarrh, kept up by a weakened state of the habit, in chronic diarrhœa, in passive hæmorrhages, in scrophulous states of the system, in dyspepsia, anorexia, and in every case of direct debility, it may be prescribed with undoubted advantage. I am in the daily habit of prescribing the Cinchona, and its preparation the sulphate of Quinia, in cases which are improperly termed neuralgia, in which the pain returns at stated intervals, and in that peculiar inflammation of the sclerotic coat of the eye which assumes the characteristic of rheumatism, in which it may be regarded almost in the light of a specific.

But, notwithstanding the substantial benefit resulting from the administration of Cinchona, and sulphate of Quinia and Cinchonina, in these diseases, some caution is requisite to be observed in prescribing them. They are hurtful when hepatic symptoms are present; and consequently their employment should be prefaced by one or two doses of a purgative; and they should never be ordered until all inflammatory symptoms are subdued by bleeding and other means. Local and topographical circumstances also vary the efficacy of Cinchona Bark. Thus, Mr. Annesley, in his elaborate work on the Diseases of India, states that, although the bark is the grand remedy in fevers in India during the cold season, yet it fails in the rainy season, in which calomel and antimony only prove useful.

The pharmaceutical preparations of Cinchona are a subtile *powder, infusion, decoction, tinctures, and extracts*; besides the sulphates of Cinchonina and of Quinia. The powder was formerly given in doses of gr. x to 3vi, every second or third hour, during the intervals, or intermissions in agues: but the bulk of the powder was always regarded as a disadvantage to this form of the medicine. The bulk of the dose alone was often such as to nauseate. Thus Cullen says that doses of ʒii were the smallest he ever found beneficial in intermittents; and that, when a more powerful effect was requisite, he ordered ʒiv for a dose. The best vehicle for administering it is milk, which effectually covers the flavour of the bark, if the dose be swallowed the instant it is mixed with the milk.

If decoction be preferred, care should be taken not to prolong the boiling beyond ten minutes; as long boiling converts the tannin into oxidized extractive, which, precipitating, carries down with it much of the kinates. Infusion in boiling water, acidulated with diluted sulphuric acid, is a preferable preparation. In the decoction, the precipitates formed on cooling should be suspended in the fluid by means of mucilage; for these contain a large proportion of the kinates. The decoction has proved very beneficial, in combination with the chloro-sodaic solution, or with muriatic acid, as a gargle in malignant scarlatina; and, also, as a lotion in external sores of a gangrenous description. In these cases, the bark changes the morbid action of the part, and aids cicatrization.

The tinctures of Cinchona contain all the active principles of the drug; the alcohol dissolving the kinates of the alkaloids, and scarcely acting upon the kinate of lime. A wine is employed on the Continent, and in this country wine is often used as a vehicle for the powder.

The extracts are prepared both with water and with alcohol; the alcoholic extract contains more of the active constituents of the bark: if it be repeatedly washed with distilled water, the whole of the kinates are taken up, and the red insoluble matter only remains. By evaporating this solution, the natural kinates can be readily obtained.

But the best preparations are the neutral salts of the alkaloids. The sulphate of Quinia is preferred, and is in most general use. It may, indeed, be reasonably demanded, in what do these salts differ? We are already acquainted with their chemical differences. In a medicinal point of view, my own experience does not authorize me to assert that they possess any peculiar properties not common to both. M. Bally, however, has stated that the sulphate of Cinchonia is more stimulant than the sulphate of Quinia. To obtain the full effect of the sulphate of Quinia, in ague, the best mode of prescribing it is to dissolve two or three grains in an infusion of the confection of roses, filtered, and acidulated with diluted sulphuric acid, with the addition of fʒi of tincture of orange peel, which covers the extreme bitterness of the solution;

for it is a curious, although not easily explained, fact, that the bitterness of the sulphate is completely covered by aromatic bitters, such as gentian root, orange peel, and cascarilla. This dose of the sulphate of Quinia, thus combined, should be given every second hour, before the paroxysm occurs, so that the last dose may be taken one hour only before the anticipated attack. I have given it, in appropriate doses, to infants labouring under intermittent fever, with the best effects. Dr. Elliotson says, that the preferable mode is to give a large dose—gr. x, for instance—either before or immediately after the paroxysm. In my practice, small doses, frequently repeated, have proved more useful than a large dose.

Signor Broglia dal Persico proposes to cure agues by dusting the sulphate, in fine powder, on blistered surfaces; and he affirms that the salt thus applied may be detected in the stools.

In those states of the habit in which catarrh assumes an intermittent type, and in which the periodical attacks depend on a weak and imperfect action of the cutaneous function, and this again on a defective action of the heart and arteries, I have found no remedy so beneficial as sulphate of Quinia, administered in the manner I have just described. In strumous affections, particularly when the eye is the obvious seat of disease, as when the cornea is inflamed, with a certain degree of inflammation of the iris also, Mr. Mackenzie has found the sulphate of Quinia most serviceable. In some substances, however, when taken into the stomach, it has produced symptoms almost indicative of inflammation of that organ; to obviate which, M. Pointe, a physician in Lyons, has proposed to administer it externally, so as to be taken into the habit by absorption. His plan is to rub the gums and the inside of the cheeks with the sulphate, very finely powdered; continuing the friction for ten or fifteen minutes, or until all the powder be absorbed: the patient is cautioned not to swallow the saliva. He affirms that the sulphate, thus applied, acts with as much energy as when taken into the stomach, without exciting the irritation of the mucous membrane, which, he contends, it is apt to induce.

The sulphates of Quinia and Cinchonia may be also

administered per anum: they cure ague, but cause violent colic.

d. PIPERINA.—This is a peculiar principle, which was discovered by M. Oerstadt, of Copenhagen, in Black Pepper. Its discoverer regarded it as an alkaloid; but M. Pelletier disproved this, and maintains that Pepper contains no alkali. Piperine is procured crystallized in flattish quadrilateral prisms, with two parallel large and two small sides, terminated by an inclined plane, of a pale yellow colour, or nearly colourless, and semitransparent. These crystals are insoluble in cold water, scarcely soluble in hot water, precipitating as the water cools: they are soluble in alcohol at all temperatures. The alcoholic solution is rendered milky on the addition of water, like resinous spirituous solutions. It is also soluble in acetic acid. The diluted mineral acids do not act upon it, but the strong acids alter its properties: thus, sulphuric acid gives it a *blood-red* colour; the nitric first produces a *greenish-yellow*, then an *orange*, and, lastly, a *red* colour; and the muriatic changes its natural yellow to a deep *yellow* hue. It is precipitated from its solutions by carbonates of alkalies: by ferrocyanate of potassa the solution is rendered nearly opaque.

The process for procuring the Piperina is very simple. Two pounds of pulverized Black Pepper are treated with three pounds of alcohol at 36° Beaumé, carried to ebullition, then left at rest until it is cold, and decanted: this operation is repeated with fresh alcohol; and two pounds of distilled water, containing ℥iii of hydro-chloric acid, are poured on the mixed alcoholic solution. The fluid becomes turbid, and deposits a precipitate of a deep grey colour, which consists partly of a fatty matter. When this fatty matter is separated, beautiful crystals, which are Piperina, appear upon the sides of the vessel, and on the filter. By adding fresh water to the liquid as long as it becomes turbid, fresh crystals are procured. The concrete oil, which is separated in large quantity, is of a dark green colour, excessively acrid, and very soluble in alcohol. Pepper, also, contains a volatile balsamic oil, extractive, a large quantity of starch, bassorine, and malic and uric acids. The acrid oil resides chiefly in the

skin of the fruit ; when this is denuded, as in White Pepper, scarcely any acrid oil is procured. Piperina is procured by a similar process from Long Pepper, and also from chamomile flowers.

The flowers of the *Anthemis nobilis** were formerly celebrated for their power of curing agues†. With some degree of aromatic flavour and warmth, the taste of chamomile flowers is intensely bitter. Both water and alcohol extract their medicinal properties. The oil which gives the aromatic quality to chamomile flowers can be separated by distillation : it has, when recent, a blue colour, but becomes yellow by time. Boiling alcohol separates from them a concrete fat oil, which is deposited as the solution cools : it is in conjunction with this fat oil that the Piperina exists. The infusion and tincture of chamomile flowers are copiously precipitated by subacetate of lead : the sulphates of iron strike a deep blue-black with them ; they are also precipitated by decoction of yellow cinchona, the precipitate being a tannate of quinia. From these results of the action of reagents, we may conclude that, besides Piperina, chamomile flowers contain a fat concrete matter, a volatile oil, bitter extractive, tannin, and gallic acid.

The tonic properties of *Anthemis nobilis*, when given in moderate doses, has been long known ; and before the introduction of the cinchonas, the pulverized flowers were successfully administered in intermittent fevers, their efficacy being, probably, due to the Piperina they contain. In strong decoction or infusion, or in large doses of the powder, they prove emetic ; but in a light infusion, particularly in water under 120°, they are very excellent stomachics and Tonics, in convalescence from acute diseases, dyspepsia, gout, and chronic debility. Besides the form of infusion and decoction, the dose of which is from fʒiv to fʒiiss, they are administered, also, in the form of an extract ; but the heat which is necessary to be employed in preparing the

* Woodville's Med. Bot. 3rd edition, p. 47, pl. 19. London Dispensatory, art. *Anthemis*.

† Morton, Exer. 1 de febr. intermit. cap. 6. Pringle, Diseases of the Army, p. 216. Cullen Mat. Med. vol. ii, p. 79.

extract dissipates much of the volatile oil ; and, consequently, the value of the remedy, as far as regards its aromatic qualities, is deteriorated.

If we enquire into the value of Piperina as a Tonic medicine, we find that Pepper entered into many of the prescriptions of the ancients ; but it does not appear that it was employed for the cure of agues : it is not easy, therefore, to determine the origin of the popular opinion in its favour as a remedy in these diseases. A mixture, or rather tincture of Black Pepper in gin or rum, has long been regarded as a specific for ague among sailors ; but it was not until after the discovery of *Piperine* that any idea could be formed of the cause of its beneficial effects. The first satisfactory account of the medicinal properties of Pepper was published by Dr. Meli of Ravenna, in a work entitled “ Nuove Esperienze ed Osservazioni sul modo ottenerle dal Pepe nero il Peperino e l'Olio acre.” Peperina has been successfully employed in various parts of the Continent ; but it has not yet found its way into general practice in this country. Whether we can depend on the truth of the high encomiums that have been passed upon it, farther experience is requisite to determine. Thus, Dr. Gordini of Leghorn, asserts that, in periodical fevers, he has found it prove successful when sulphate of Quinia had failed. He gave it in doses of from gr. viii to gr. x every fourth hour during the apyrexia. If it be found, on farther experience, that Piperina realizes the anticipations of those who have introduced it, some method of procuring it at a more reasonable rate will be discovered ; and the re-introduction of some of our indigenous plants, such as chamomile flowers, may be attended with beneficial effects. It is probable that, owing to the form in which the chamomile has been administered, very little of the Piperina, if any, has been taken up ; and to this may be traced the failure of this medicine in modern practice. For the cure of ague, the flowers were given in substance ; thence, if Piperina be readily formed in the substances which yield it, there is no difficulty in conceiving that chamomile in powder might prove highly useful, and yet be inert in infusion, owing to the insolubility of the active principle in water.

The dose of pure Piperina is from gr. i to gr. x, three or four times a day. Owing to its insolubility in any aqueous menstruum, it must be given in the form of pills. But Piperina is rarely pure; a portion of the acrid oil of the Pepper always, more or less, adhering to it; and it is owing to this circumstance that it has been accused of producing an acrimonious effect in the stomach and bowels. In some instances its use has been followed by an eruption resembling psoriasis, accompanied with great itching. It may, however, be questioned, whether the small quantity of the acrid oil left in the Piperina be not useful*.

e. GENTIANA.—This is a yellow, inodorous, bitter principle, in the form of acicular crystals. It is not very soluble

* *The following extract of a letter from J. Adamson, Esq. of Rye, to Charles Knight, Esq., at the date of the letter one of my pupils, is illustrative of this point.*

DEAR SIR,

Rye, April 14, 1829.

The cases in which I have used the Piperine, in its *crystallized state*, have been most satisfactory. The first person upon whom I tried it was a man of the name George Avery. I visited him during the third paroxysm, and ordered one grain of Piperine to be taken every two hours between the paroxysms. The next day he had a most terrible fit of the “vulgar gripes,” which, however, was speedily removed by an aperient. The ague did not return, and he has been free from it to this day. Another man, Henry Heath, had two paroxysms. He took gr. i every two hours, and had no return. The pain in the bowels also appearing in this man, I determined, in future, to give an aperient at first starting, which has completely prevented, in other cases, any griping. Hodges, of the Staff Corps; Catt, Winchelsea Marsh; Jarratt, near the Bank; Mrs. Watson’s cook; Mrs. Wood, of the workhouse; Mrs. Peedle, and many others; have experienced equal benefit: and, I think, afford sufficient evidence of the efficacy of Piperine in intermittents. There is one case to which I wish particularly to direct your attention and recollection—Crowhurst, Vidler’s foreman. This man had suffered from ague for, I think, nine months; it could be moved by nothing. He, as you may remember, wished to try the Piperine. He took the usual dose with decided effect; for the paroxysm was evidently weakened; but, the stomach having got accustomed to the action of Piperine, whether stimulant or tonic I will not determine, the enemy returned, and there remained, in spite of the doses of Piperine, and small or large doses of sulphate of quinia, or any thing else which was given. I mention this case to shew, that, where the Piperine has failed, the sulphate of quinia has had no better effect. But I dare say you will ask—How does it answer now? To be candid, I have discontinued the use of it; not from doubting its power, but from the four following reasons:—1st, the expense of preparing it in comparison with the price of sulphate of quinia; 2dly, want of time and opportunity to prepare it; 3dly, its inconvenient form of exhibition, only in the form of pills; and, 4thly, the spirituous extract, which you remember you prepared before you left, I find to be perfectly useless; you may as well give so many pepper-corns.

in cold water; but communicates to it a powerful bitter: it is soluble in boiling water, alcohol, ether, and the alkalis: dissolved in acid, it loses its colour; but, on the addition of an alkali in excess to these solutions, its colour is deepened. *Gentiana* was discovered by MM. Henry and Caventou. It does not appear to possess either acid or alkaline properties. Exposed to the action of heat in a tube, it is partly sublimed and partly decomposed.

Gentiana may be procured from the roots of the *Gentiana lutea* and other species of the natural order Gentianæ. It is prepared by macerating the roots in alcohol, and evaporating to dryness: then dissolving the residue in distilled water, adding a small quantity of magnesia, boiling, and evaporating to dryness. The magnesian residue thus procured, when boiled in ether, yields the *Gentiana*. The solution, filtered while hot, affords crystals on cooling. A small quantity of *Gentiana* which remains cools with the magnesia on the filter, and may be procured by treating the magnesian precipitate with oxalic acid, which unites with the magnesia and leaves the *Gentiana* in a state to be taken up by fresh ether.

M. Majendie tried the medicinal properties of *Gentiana* thus carefully prepared: it proved to be an excellent Tonic, and so little poisonous as to produce no bad consequences even when injected into the veins. It is the active principle of the following plant—

GENTIANA LUTEA. Gentian Root. L. E. D.—This plant grows in great abundance in the Alps of Switzerland and Austria, the Apennines and the Pyrenees, on the mountains of Burgundy, and in North America: it belongs to the natural order Gentianæ*.

The roots, or rather underground stems, are in rough, twisted pieces: they are nearly inodorous, and have an intensely bitter but not nauseous taste. Their sensible qualities are not perfected until they are four years old: they may be extracted by ether, alcohol, and water. According to the analysis of MM. Henry and Caventou, they contain, besides the *Gentiana*—a very fleeting, odorous matter;

* Woodville's Med. Bot. third edit. p. 273, pl. 95. London Dispensatory, art. *Gentiana*.

a substance resembling bird-lime ; a green fixed oil ; a free vegetable acid in small quantity ; uncrystallizable sugar ; gum ; a yellow-colouring matter ; and lignin*. The fugacious nature of the colouring matter accounts for the effects of acids and alkalies on the infusion. Neither the salts of iron nor nitrate of silver throw down precipitates in the infusion of Gentian root—a very convenient circumstance in its medicinal administration. It is copiously precipitated by acetate of lead and by the decoction of yellow cinchona bark. Besides diluting the colour, acids greatly diminish the bitterness of Gentian root ; whilst alkalies increase both colour and bitterness. Owing to the saccharine principle contained in the Gentian, the infusion very rapidly ferments and spoils.

Fabulous history carries the discovery of the medicinal properties of Gentian to high antiquity ; assigning it to Gentius, king of Illyria, who lived 167 years before the Christian era, and after whom the plant is named†. It possesses considerable tonic powers, and holds a high rank among remedies for dyspepsia, when tonics are admissible ; exciting appetite and promoting digestion. Cullen says that Gentian, combined with galls or tormentil, in equal parts, and given in sufficient quantity, cures intermittents ; which teaches us the advantage of combining astringents with Gentian and other bitters when we desire to extend their influence to the system. This root had formerly a high character as a gout medicine, and formed a large proportion of the celebrated Portland powder. It is particularly applicable in such diseases as require the combination of bitters and chalybeates, as scrophula, amenorrhœa, worms, and similar affections. The best form for administering Gentian is the infusion ; and the facility of combining it with acids, or alkalies, or the metallic salts of silver, iron, and zinc, renders it an excellent vehicle

* Journ. de Pharm. tome vii, p. 173.

† It formed a part of the celebrated antidote of Mithridates, which, says Celsus, was called most noble : “ quod quotidie sumendo rex ille dicitur adversus venenorum pericula tutum corpus suum reddidisse ”—an excellent commentary on the state of medicine at that period, and a striking instance of the antiquity of that credulity which still adheres to titled ignorance on the subject of remedies.

for these powerful medicines in all cases of direct debility*. The infusion ordered in the Pharmacopœia is a compound of Gentian, orange peel, and lemon peel. The tincture is a compound of the same kind; but, in my opinion, few medicines require such additions so little as Gentian. The simplest and best preparation is the extract, which may be given in doses of from ten grains to half a drachm, twice or thrice a day. It is an excellent vehicle for sulphate of quinia.

The *Gentiana Chirapita* of Roxburgh has long been used as a Tonic, in dyspeptic affections, in India; and has lately been introduced in England as a gout medicine. MM. Las-saigne and Boissel have analyzed it, and found in it—a yellow bitter principle; a brownish colouring matter; resin; gum; malic acid; malate of potassa; silex; and some traces of oxide of iron†. It does not appear to possess any advantages over Gentian.

f. SALICINA.—This is an alkaloid discovered by MM. Belke, Buchner, and Leroux, in the bark of some species of the wil-low tribe‡. It is procured in white, acicular, prismatic crystals, very bitter, inodorous, little soluble in cold but very soluble in hot water, soluble also in alcohol, but not in ether nor in volatile oils. Sulphuric acid reddens it deeply; nitric and muriatic acids dissolve it; and it may be changed into resin by the action of these acids. It is procured nearly in the same manner as quinia. Salicine is not precipitated from its solution by infusion of galls, acetate of lead, alum, or tartar emetic. According to Pelouze and Gay-Lussac, it consists of

Carbon	2 prop.	$(2 \times 6) = 12$,	or 55.491
Hydrogen	2 prop.	$(1 \times 2) = 2$	8.184
Oxygen	1 prop.	$= 8$	36.325
		Equivalent 22	100.000

* It is said that the root of the *Gentiana acaulis*, a beautiful indigenous mountainous species, with a solitary, large, bell-shaped flower, possesses all the medicinal properties of the yellow Gentian root without the disadvantage of the gum. This deserves a trial.

† Journ. de Pharm. tome vii, p. 285.

‡ Journ. de Pharm. 1829. The species of *Salix* in which it has been found are *S. fissa*, *S. helix*, *S. amydalina*, *S. vitellina*, and *S. incana*: it has also been procured from *Populus tremula*, *P. nigra*, *P. Græva*, *P. angulata*, and *P. alba*.

The following species of *Salix*, which are officinal, owe their tonic powers to *Salicina*.

1. *Salix fragilis*, Crack Willow, D., an indigenous species growing upon the banks of rivers, flowering in April and May. The bark is the part employed.

2. *Salix Caprea*. Round-leaved Willow. L. D.—This is also an indigenous species, the bark of which is bitter and tonic, and has been employed like the other species.

3. *Salix alba*. White Willow. D.—This species was recommended for the cure of intermittents by Dr. Stone. The bark, when dry, is of a brown colour within: it is very intensely bitter, acrid, and slightly aromatic. According to the analysis of Pelletier and Caventou, it contains—a brownish-red matter, soluble in alcohol, but little soluble in water; a green fatty matter, soluble in alcohol and ether; tannin, resulting from the combination of an acid and a colouring matter, which affords an abundant precipitate with gelatin, but not with tartar emetic; gum; and lignin. Since that period, *Salicina* has been discovered, and completes the analysis.

It was evident that this bark possessed a tonic power; and experience has fully confirmed its influence as an antiperiodic remedy in intermittents. It requires, however, to be administered in large doses: thence the great advantage of *Salicina* in a pure state. Willow bark may be administered in powder, or infusion, or decoction, or in that of tincture, which contains all the active principles of the bark. *Salicina*, like quinia, has nearly superseded the use of the bark.

g. QUASSINA.—This is not a simple vegetable principle: it is obtained by evaporating a strong decoction of *Quassia* chips to the consistence of an extract; is semitransparent and of a brownish-yellow colour, soluble in water and in diluted alcohol, or what is termed proof spirit, but not in strong alcohol and ether. The aqueous solution of *Quassina* precipitates the persalts of iron in yellow flakes, the acetate of lead also in yellow flakes, and the nitrate of mercury white. It does not precipitate tartar emetic, and does not throw down the protosulphate of iron, as it contains no traces of either tannin or gallic acid. *Quassina* is the active principle of the following substances.

QUASSIÆ EXCELSÆ LIGNUM, Quassia Wood, L. E. D*. a plant which is a native of Jamaica and the Caribbeean Islands, belonging to the natural order Simarubaceæ.

Quassia wood is brought home in billets, and cut into the chips found in the shops. Water is the best vehicle for taking up its medicinal properties; and the infusion is, in fact, a weak solution of Quassina; so that it is affected by the same reagents as the solution of Quassina.

Quassia was first introduced, as a medicinal agent, from being used as a secret remedy in fever, by a negro in Surinam, called Quassi, after whom the plant is named. It was at one time vaunted as capable of curing intermittents; but it has not maintained that character, although it still is regarded as a powerful Tonic; and, from being of a nature to admit of admixture with the sulphate of iron, of zinc, and some metallic salts, it is advantageously given in chlorosis and other obstructions of the catamenia. In fevers, it may be administered in every stage of the disease, as it neither quickens the pulse, nor augments the animal heat, nor operates on the bowels†. In combination with cretaceous powders, or the alkalies, and aromatics, it is a useful remedy in atonic gout; but, if any irritation exist in the stomach, it is injurious. Its vermifuge powers have been well ascertained; but all Tonics may be regarded as vermifuges. On the Continent, persons of sedentary habits take a table spoonful of the infusion of Quassia an hour before dinner, as an aid to digestion. In South America, basins are made out of the wood of the Quassia, which are employed by dyspeptics, the wood communicating its bitter to the beverage which is put into it, and thence proving Tonic.

2. QUASSIÆ SIMARUBÆ CORTEX. *Simaruba Bark.* L. E. D.—This species of Quassia is a native of Guyana and Jamaica. The bark of the root of this tree is officinal. It had been long employed by the inhabitants of Guayana before it was introduced into Europe in 1713. It is brought from Jamaica in bales, and the pieces folded lengthways. It is very fibrous, thin, light, greyish or whitish exteriorly, and

* Woodville's Med. Bot. third edit. p. 574, pl. 201. London Dispensatory, art. Quassia.

† Murray Apparatus Medicam.

interiorly of a light reddish brown hue and warty. It is inodorous, and impresses a very bitter taste.

According to the analysis of M. Morin, of Rouen, Simaruba contains a resinous matter, a volatile oil having the smell of benzoin, malic acid, traces of gallic acid, Quassina, ulmin and lignin, acetate of potassa, an ammoniacal salt, malate of potassa, and an oxide of iron*.

The infusion contains all the virtues of the bark. It is precipitated by infusion of yellow bark and some other reagents, which do not affect the infusion of Quassia; but more particularly by the bichloride of mercury and the alkaline carbonates. It is distinguished by the volatile oil, with which the bitter principle is combined, and which, undoubtedly, adds to its powers as a Tonic. The gallic acid which it contains prevents the sulphates of iron from being combined with it, in the manner in which they may be exhibited with the decoction of Quassia. The decoction deposits a copious resinous precipitate on cooling. In medicinal properties, the Simaruba Bark has not maintained the high character which introduced it into notice. It is now little employed, although it is a Tonic of considerable power, and has been justly regarded as the best remedy of the class in the treatment of dysentery; in which, however, it ought not to be given until the inflammatory and febrile symptoms have abated. At this period, when the tenesmus continues, with a weak, sinking pulse, it allays this uncomfortable symptom, and any griping with which it may be accompanied, favours the secretions of the skin, and restores the tone of the intestinal canal.

Simaruba Bark is most advantageously administered in the form of infusion. It is sometimes given in substance, in the form of powder, in doses of gr. xv to 3ss, combined with opium and aromatics; but it is an inconvenient form of the medicine.

3. *CHIRONEA CENTAURIUM. Lesser Century. L. E. D.*—This is a beautiful indigenous plant, which enlivens the fields

* Journ. de Pharm. Feb. 1812.

with its pink corymbs of flowers in July and August. It belongs to the natural order Gentianeæ*.

The infusion and decoction of the Lesser Century form a precipitate of an olive green with the sulphates of iron, and the alcoholic solution leaves a resin when evaporated. Vauquelin found that it produces no precipitate with tartar emetic nor with gelatin. M. Moretti analyzed the summits of Lesser Century, and obtained a free acid, mucus, bitter extractive, lime, and hydrochloric acid, which was probably united to the lime. M. Chevallier procured from these summits a bitter crystallized matter†.

As a medicinal agent, the Lesser Century does not possess any properties different from those of Gentian and many other bitters; and, therefore, it might be advantageously rejected from the list of the Materia Medica.

g. BITTER EXTRACTIVE.

Extractive is found in many tonic vegetables, in combination with *fecula*, *gallic acid*, *tannin*, and *volatile oil*. In most works on chemistry which treat of vegetable bodies, it is mentioned as if it were a well-defined substance. Schrader is said to have obtained it pure from the bark of the *Cinchona lancifolia*. It is, nevertheless, difficult to say what Extractive is, in a strictly chemical point of view. The term is applied to that solid transparent residue which remains, in combination with other principles, when a vegetable infusion is slowly evaporated; which is insoluble in pure alcohol; which is oxidized and rendered insoluble in water, when the solution containing it is long boiled; which forms an insoluble yellow precipitate when acted on by chlorine; which is rapidly precipitated by muriate of tin; and, finally, which is fixed as a dye, of a fawn-brown hue, by any substance yielding oxygen. Bitter Extractive is contained, in considerable quantity, in many roots, herbs, barks, and leaves, which possess tonic powers.

Extractive is inodorous; but it differs in taste according to the plant which yields it; thence it is probably never obtained in perfect purity. When the solution of Extractive is eva-

* Woodville's Med. Bot. 3rd edition, p. 275, pl. 96. London Dispensatory, art. Chironea.

† Journ. de Pharm. tome v, p. 98.

porated slowly, the residue is transparent; when rapidly, the oxidizement which occurs renders the Extractive opaque, and it ultimately loses its insolubility in water. This effect of boiling, or that of rapid evaporation on Extractive, explains the reason why long decoction of some of the medicinal barks renders them nearly inert; why extracts, not slowly prepared in a water bath, are seldom active medicines; and, also, why extracts prepared in vacuo are preferable to all others. The effect of alum, alkalies, and many of the metallic salts and the oxides, on vegetable infusions and decoctions is explained by the result of these reagents on pure Extractive. Insoluble, consequently nearly inert precipitates, are thrown down; and, therefore, these reagents are incompatible in all vegetable infusions containing Extractive. Its presence is always easily ascertained by muriate of tin, and the power of the infusion or decoction to fix a permanent fawn colour on cotton soaked in alum. When submitted to destructive distillation, Extractive yields carbonic acid gas, carburetted hydrogen gas, and, if the heat be great, ammonia: thence, we conclude that its ultimate components are—carbon, hydrogen, oxygen, and nitrogen.

* *Roots containing Bitter Extractive.*

1. CALUMBÆ RADIX. *Calumba Root*. L. E. D.—This root was used long before the plant which yields it was known: it was named from Calumbo, the place of its export in Ceylon. By the careful examination of a plant, reared from a root brought from Africa and planted in the Botanic Garden at Madras, De Candolle discovered it to be a *Coculus*, and named it *Coculus palmatum*. It belongs to the natural order Sargentaceæ, or Menispermæ*. It grows in great abundance in the forests of Mozambique, where it is dug up in March by the natives, and transported to Tranquebar, whence it is shipped for Europe.

This root is in transverse sections, of rather more than the third of an inch in thickness, and from an inch to two inches in diameter. The centre, which is spongy and of a pale brown

* Woodville's Med. Bot. 3rd edition, vol. v, p. 22. London Dispensatory, art. Calumba.

colour, is covered by a thick, easily detached bark, the interior of which is of a bright yellow hue ; and the epidermis or cuticle olive-brown and much wrinkled. The disks or pieces are generally concave on both sides, owing to the shrinking of the spongy interior part in drying. The best specimens of the root are those slices which are least worm-eaten, solid, and heavy.

Calumba root has a slight, aromatic odour, and a bitter taste ; it is brittle, breaks with a starchy fracture, and is easily powdered. Boiling water and alcohol extract its virtues ; but proof spirit is its best menstruum. The aqueous infusion strikes a beautiful blue with tincture of iodine ; and this is the best test for distinguishing the true root from a *false Calumba*, which has lately been sent from the Barbary states*. The aqueous infusion of true Calumba is precipitated by infusion of galls, yellow cinchona bark, acetate of lead, bichloride of mercury, and lime water ; but not by muriate of baryta, sulphate of iron, nitrate of silver, nor tartrate of antimony and potassa. According to the chemical analysis of M. Planché, Calumba root contains—starch, about one-third of its weight ; a yellow azotized matter ; a bitter yellow principle, not precipitated by the metallic salts ; traces of a volatile oil ; woody fibre ; salts, consisting of bases of lime and of potassa ; oxide of iron, and silex†. A new crystallized principle, *Calumbine*, has been procured from Calumba by digesting the powdered root in ether, filtering, and evaporating. It possesses the bitter taste of the root : its properties require examination.

Dr. Duncan supposed that Calumba root contains cinchonia ; and certainly the action of reagents on its aqueous decoction apparently confirms his opinion : but the examination of the root, by M. Planché and M. Guibourt, has not detected this principle in Calumba. The central part, or pith, contains little or no bitter extractive ; and should,

* This false Calumba is further known by its white colour, lighter texture, and its taste, which is at first sweetish, and not half so bitter as that of the true Calumba. Its infusion also reddens the tincture of litmus ; caustic potassa disengages ammonia from it ; salts of iron precipitates its infusion black ; and ether, digested on it, acquires a bright yellow colour ; none of which effects are presented by true Calumba.

† Bull. de Pharm. t. iii, p. 289.

therefore, be separated before making an infusion or decoction of the root. The tonic properties of Calumba have been known since 1685: and, as it possesses no astringency, and is little stimulant, it is perhaps the best Tonic in phthisical cases. It has a considerable power in allaying the irritability of stomach accompanying pregnancy and dyspepsia: and, occasionally, attending dentition. Dr. Denman recommended it in the low stage of puerperal fever: and, as a Tonic, in combination with rhubarb and sulphate of potassa, I have found it extremely useful in the mesenteric affections of infancy and childhood. The dose of Calumba root in powder, is from gr. xv. to ʒi. When taken alone, in the form of powder, it is said to exert a purgative effect, according to the experiments of Dr. John Davy. The infusion and decoction soon spoil, and are, therefore, objectionable preparations in that respect. One great advantage of the Calumba is, the facility with which it can be combined with the salts of iron. Calumba root is one of a few vegetable medicines which should be given in the form of tincture; the alcohol taking up the active principles only of the root. The dose of the tincture is from ʒi to ʒiii, and even more if the patient have been accustomed to the use of ardent spirits.

2. *GEI URBANI RADIX. Common Avens. L. E. D.*—This is the root of an indigenous plant, belonging to the natural order Rosaceæ*, growing very abundantly in woods and thickets, flowering in June, July, and August.

The roots, which are the parts employed, should be dug up in spring; they have a fragrant odour, not unlike that of cloves; the taste is austere and bitter. In distillation it yields an aromatic oil in small quantity. According to the analysis of Melandri and Moretti, it contains resin, tannin, gallic acid, oxygenizable extractive, soapy extractive, muriates of potassa and magnesia, nitrate of potassa, malate of lime, mucus, lignin, and volatile oil†. Tromsdorff, also, analyzed the roots of Geum, and procured tannin, resin, volatile oil, tragacanth, gummy matter, lignin, and a trace of sulphur‡.

Avens has been little employed as a Tonic in this country;

* Woodville's Med. Bot. 3rd edition, p. 502, pl. 181. London Dispensatory, art. Geum. † Bulletin de Pharm. t. ii, p. 358. ‡ Journ. de Pharm. t. v, p. 310.

but, on the Continent, it is much employed in intermittents; and in convalescences from acute diseases. Augsburg beer, which is considered as an excellent preventive of ague in the fenny parts of Germany, owes its properties to the Geum Urbanum, a small bag of the bruised root of which is put into each cask. It is also regarded as a useful corroborant in chronic diarrhœa and in scurvy. The best mode of administering Avena is in powder, but it is also administered in the form of decoction, one ounce of the bruised root being boiled in one pint of water and strained. The dose of this decoction is from fʒi to fʒiss, three or four times in the day.

* * *Entire Plants.*

1. CETRARIA ISLANDICA. *Physica Islandica, Iceland Liverwort, or Moss.* L. E. D.—This is a lichen, not a moss; it is found not only in Iceland, and other parts within the Arctic circle, but on the mountains of central Europe, the Alps, the Pyrenees, Jura, and many of the mountains in the northern part of our Island. It grows in tufts, sometimes on the rocks and arid places, but not unfrequently in the pasturage on mountains. It holds a place among the *Cellulares*, in the order Lichenes of the natural arrangement*. It is more generally employed as an article of diet for the convalescent, than as a Tonic.

This Cetraria has no sensible odour, but a very bitter, somewhat astringent taste. It has been analyzed by several chemists: the analysis of Berzelius is that most to be depended on: he ascertained that it contains in 100 parts—saccharine matter 3.6; bitter principle 3; bitartrate of potassa 1.9; green wax 1.6; extractive 7; gum 3.7; fecula 44.6: woody fibre 34.6. Its astringency is stated to depend on traces of gallic acid; this, however, is doubtful, as the salts of iron do not indicate it when added to the decoction. On the contrary, the sulphates of iron produce a reddish or portwine colour with the decoction, which is probably owing to the action of the free tartaric acid of the bitartrate of potassa. The extractive is developed by muriate of tin; the gum by subacetate of lead; and the fecula by the tincture of iodine.

* Woodville's Med. Bot. 3d edit. p. 804. pl. 271. London Dispens. art. Lichen.

The tonic powers of Iceland lichen depend on the bitter principle; and, therefore, when it is employed as a Tonic, which has been the case, for some years past, to a considerable extent in the latter stage of phthisis, the bitter should not be wholly removed. Even when it is to be employed as nutriment, there is too much anxiety to remove the bitter, a small portion of which is requisite for aiding the digestion of the fecula. But, as the bitter is very nauseous to many palates, a part of it may be removed by boiling the lichen twice, and adding to the first boiling a small quantity of any alkaline carbonate. In this state, combined with milk, it forms an excellent article of diet in convalescence from the remittent of childhood, and in dentition. The addition of five or six minims of diluted sulphuric acid, and fʒi of syrup of white poppies, to fʒiss of the decoction, affords an excellent Tonic in phthisis, and in cases of great emaciation from acute disease. In cases of chlorosis and imperfect menstruation, the decoction may be advantageously combined with sulphate or muriate of iron, as in neither case is any precipitate produced.

* * * *Leaves.*

1. MENYANTHIS TRIFOLIATÆ FOLIA. *Leaves of Marsh Trifol.* L. E. D.—March Trifol, or Buckbean, is an indigenous plant, growing in marshes; belonging to the natural order Gentianæ*. According to Tromsdorff, it loses 75 parts in 100 of its weight in drying; what remains consists of bitter extractive; a peculiar substance approaching to the character of animal matter; a brown gum; malic acid, acetate of potassa, and fecula.

The leaves are the parts of Menyanthes medicinally employed; they yield to boiling water an intensely bitter nauseous taste. The infusion strikes a deep black with persulphate of iron, shewing the presence of gallic acid; throws down a copious precipitate with alum and muriate of tin; and also precipitates infusion of yellow cinchona bark. It is acted upon by chlorine, which separates the extractive, rendering it insoluble.

* Woodville's Med. Bot. third edit. p. 177, pl. 97. London Dispensatory, art. Menyanthes.

The Buck-bean or Marsh Trifol is an admirable Tonic, and would be much prized if it were less common. In large doses the infusion excites vomiting; and, under certain conditions of the body, purges or acts as a diuretic, as the surface is more or less exposed. It stops intermittents, and is peculiarly useful in rheumatism when it takes an intermittent character. It may be given either in substance, in doses of from ʒi to ʒi of the powder; or in infusion. On account of its nauseating properties, it is useful to combine it with aromatics.

2. *ARBUTUS UVA URSI*. *Bear's Whortleberry*. L. E. D.—This is also an indigenous plant, a native of most of the mountainous districts of Europe. It belongs to the natural order Ericaceæ*. Like its congeners, it is an evergreen shrub, low, and trailing on the ground. Its leaves are obvate, nearly obtuse, firm, and glossy, of a deep green on the upper disk, and paler on the under. Their entire edge, and their thick, firm texture, distinguish them from those of the *Vaccinium* *Vitis* *Idea*, *Cow-berry*, with which they are often mixed.

The leaves of *Uva Ursi* have no sensible odour; their taste is extremely acerb and astringent. When triturated with cold water, the infusion strikes a beautiful deep blue with persulphate of iron, from the large proportion of gallic acid which they contain. *Uva Ursi* possesses tonic powers; and has been employed in convalescence from diarrhœas, and in leucorrhœa. It displays considerable action on the urinary organs.

Uva Ursi has been recommended by Dr. Bourne in phthisis pulmonalis; but the remedy has not succeeded in the hands of other practitioners. He combined ten grains of the powder of the leaves of the plant with fifteen grains of cinchona bark and half a grain of opium, and gave this mixture three times a day. The effect of this mixture was to lower the pulse without adding to its force: it palliated the symptoms, and, in some cases, appears to have effected a cure. *Uva Ursi* may be given in the form of infusion; but, as little more than the gallic acid is taken up by the water,

* Woodville's Med. Bot. third ed. p. 288, pl. 100. London Dispensatory, art. *Uva Ursi*.

the powder is preferable when the tonic influence of the leaves is required. The dose of the powder is from ten grains to half a drachm.

3. CNICI BENEDICTI FOLIA. D. *Centauriæ Benedictæ Herba*. E. *Leaves of the Blessed Thistle*.—This species of *Cnicus* is a native of Spain and the South of Europe, belonging to the natural order *Compositæ**. The leaves have scarcely any odour, but an intensely bitter taste. They have been analyzed by M. Morin, of Rouen, and found to contain—a bitter principle, more soluble in hot than in cold water, and very soluble in alcohol and ether; a resinous substance; a green fatty matter; liquid sugar; gum and albumen; a little volatile oil; nitrate of potassa and malate of lime; several mineral salts; some oxides; and traces of sulphur. This analysis does not bring to light the active principle of the plant.

The infusion of *Cnicus benedictus*, the best form of using the plant, acts powerfully upon the stomach, and, in large doses, operates as an emetic, and sometimes purges. In small doses, its influence is directly tonic; and this is accompanied with a marked action on the cutaneous capillaries. The local action of this *Cnicus* is extended by nervous sympathy to the system generally; and therefore its tonic powers become conspicuous. It has been successfully administered at the moment of the expected accession in intermittents, and has arrested the course of the paroxysm. In the intervals, the infusion may be taken to the extent of a small cupful three times a day with advantage; or from ten grains to half a drachm of the powdered leaves may be taken in wine. It is also prescribed in gout and in chronic rheumatism, and very successfully as a worm medicine, which may be attributed to its bitter and tonic properties.

On the Continent, where this Tonic is more frequently employed than in this country, both the powder and the infusion are ordered. The dose of the powder is from ten grains to half a drachm, when its tonic influence only is required; that of the infusion, which is made with half an ounce of the

* Woodville's Med. Bot. 3rd edition, p. 34, pl. 14. London Dispensatory, art. *Centaurea*.

dried plant and a quart of water, is a fluid ounce and a half twice or three times a day.

h. VOLATILE OIL.

Volatile oil can be regarded as a Tonic only when it is in combination with other vegetable principles. In the state in which it is contained in the following substances, it is peculiarly adapted to exert a tonic influence.

1. *CASCARILLÆ CORTEX*. *Cascarilla Bark*. L. E. D.—The plant yielding this bark, the *Croton Cascarilla*, is a native of South America, particularly in Peru, the Bahama Island, and Virginia. It belongs to the natural order Euphorbeaceæ*. This bark is generally brought home in quilled pieces, thin, compact, and breaking with a resinous fracture. The epidermis is whitish, rough, cracked, and covered, like the cinchona bark, with various lichens, some of which are very elegant, and belong chiefly to the Graphideæ.

The bark of the *Cascarilla* has a bitter and slightly acrid taste, and an agreeable, aromatic odour, which is communicated to the infusion and decoction. This odour, which depends on the volatile oil the bark contains, is exhaled when the bark is burnt; on which account it is used in India to diffuse an agreeable smell, resembling musk, in the houses of the natives. Its active properties are taken up both by alcohol and water. According to Tromsdorff, the analysis yields mucilage, bitter extractive, resin, volatile oil, water, and woody fibre; but, from the effect of various reagents, it evidently contains also gallic acid and tannin. Its infusion yields precipitates with sulphate of iron, acetate of lead, tartrate of antimony and potassa, lime water, and infusion of yellow cinchona bark.

Cascarilla is a very valuable Tonic; its aromatic qualities greatly aiding its tonic powers in dyspeptic affections. It was introduced into practice in 1690 by Professor Stisser†, and was employed as a substitute for cinchona bark in the cure of intermittent and remittent fevers; but its powers in these diseases were greatly overrated. It is usually said to be an excellent addition to cinchona; but this refers to the pale

* Woodville's Med. Bot. third edit. p. 629, pl. 222. London Dispensatory, art. *Croton*.

† Art. Laborat. Chym. Spec. c. 9.

cinchona only, as it precipitates the infusion and decoction of the yellow bark. It is advantageously administered in asthma, flatulent colic, the latter stage of dysentery, and in diarrhœa; and indeed in every affection in which the combination of a Tonic and an aromatic is indicated. In the gangrenous thrush of infancy it is peculiarly serviceable; and no less so in that state of languor and emaciation, accompanied with a tumid, tense abdomen, which depends on obstruction of the mesenteric glands. The volatile oil of Cascarilla, whilst it is useful in some cases, excites too powerfully to permit this bark to be employed where there is the least tendency to inflammatory action. It has also been supposed to favour a determination of blood to the hæmorrhoidal vessels.

The powder of the bark may be administered in doses of twelve grains to a scruple; but it is most frequently prescribed in the form of infusion, to which the compound tincture of cinchona is an admirable addition.

2. ACORI CALAMI RADIX. *Root of Sweet Flag.* L.E.—The physical characters of this root and the chemical properties of the volatile oil on which its exciting properties depend have been already described (p. 194); what share this oil has in the tonic power which this rhizome undoubtedly possesses is not so obvious. In the fenny counties, and in Holland, its influence in curing agues is well known; and I have had sufficient experience of its powers, in my own practice, to authorize me to regard it as one of the best additions which can be made to any of the more decided Tonics in the treatment of intermittent fever. I have seen both the bark and the sulphate of quinia succeed in curing the disease when combined with the Acorus Calamus, in powder, although they had previously failed when administered alone. Whether the volatile oil of the Acorus, which is now procured in a separate state, if administered in the form of an oleo-saccharum, in combination with the sulphate of quinia, would be productive of the same beneficial effects as the powdered rhizome, has not yet been determined. It is rather remarkable that all the volatile oils, in this mode of combining them with infusions and decoctions of simple bitters and with solutions of tonic salts, are not employed instead of the substances from which they are ex-

tracted. The former often contain substances which decompose the salts and render them inert; whereas, no such effect would follow the combination of the volatile oils with these powerful Tonics; whilst their efficacy would be greatly augmented by the addition of the aromatic. To illustrate this remark by an example, let us suppose that sulphate of quinia is administered with the aromatic powder of the Pharmacopœia, the salt would be decomposed and an inert tannate of quinia formed; but, were the volatile oils only of each of the aromatics separated and combined with the salt, much advantage would be derived from the combination, without the smallest risk of decomposition. Although, in some instances, a simple Tonic, devoid of any exciting property, is desirable, yet, in the greater number of cases requiring the aid of Tonics, the addition of an aromatic is rather beneficial than injurious.

MYRRH. L. E. D.—'This is a vegetable production; but from what plant it is procured, or whether it is a spontaneous exudation from the plant, or obtained artificially in the same manner as some other gum-resins, are circumstances which are still involved in mystery. This is remarkable, when we consider the early notice of Myrrh in Scriptural history*. The probability, however, is, that Myrrh is a spontaneous exudation. Bruce, the Abyssinian traveller, imagined it to be the production of a *Mimosa*; but his reasons for so thinking are unsatisfactory: Loureiro supposes it to be obtained from a species of *Laurus*: and others think it comes from an *Amyris*: but none of these conjectures merit attention.

Myrrh is imported into this country both from the Levant and the East Indies; but, in both instances, it is the same substance, the produce of Arabia†.

Myrrh is in irregular masses, and sometimes in tears; of

* "And they lift up their eyes and looked and beheld a company of Ishmaelites came from Gilead with their camels, bearing spicerie, and balm, and Myrrh, going to carry it down to Egypt."—Genesis, chap. xxvi, v. 25.

† Vauquelin, the distinguished French chemist, when treating the root of a species of grass from Arabia, the *Anthropogon Schananthus*, obtained an oil from it of a sharp taste and a peculiar odour, not unlike that of Myrrh. He ascertained that, when this oil is united to gum or mucilage, it forms an artificial Myrrh, closely resembling natural Myrrh.

a reddish-yellow colour; nearly opaque; brittle; breaking with a vitreous fracture; and easily powdered. The taste of this gum-resin is bitter and slightly aromatic, especially when fresh pulverized, and not disagreeable. It feels fat and greasy under the pestle, owing to the volatile oil adhering to its resin. It is not fusible, and not easily inflamed. It is heavier than water, its specific gravity being 1.360. When the masses are dark-coloured, with an unpleasant odour, the drug is bad and ought to be rejected. The best Myrrh adheres to the teeth when chewed, and renders the saliva milky.

Myrrh is partially soluble in water, forming with it an opaque, yellow solution; but a deposition of nearly the third of the suspended matter occurs by rest. Alcohol takes up the portion of Myrrh insoluble in water, and forms a tincture, which water renders opaque and whitish, but throws down no precipitate. The portion insoluble in alcohol is soluble in water, and resembles Acacia gum, except that it is slowly precipitated by bichloride of mercury and superacetate of lead, and combines with the oxides of these metallic salts: it also acquires cohesion, and becomes nearly insoluble when evaporated to dryness. When Myrrh is distilled, a heavy fixed oil is procured. It is soluble in the alkalies: nitric acid changes it into oxalic acid. According to the analysis of Pelletier, Myrrh is composed of—

Resin, combined with volatile oil, .	34.68
Gum	65.32
	100.00

The resin, deprived of the volatile oil, is tasteless and inert*.

Myrrh is a stimulant Tonic, well adapted, when exhibited in the entire state, for the relief of humid asthma and chronic catarrh. The watery solution, in combination with nitrate of potassa, foxglove, opium, and camphor, or with sulphate of zinc, or sulphate of iron, is often administered in pulmonary

* Myrrh was used for various purposes by the ancients. According to Plutarch, in his Dissertation de Isse et Osire, it entered into the composition of the famous *Zulphi*, which, it is stated, inflamed every night to the setting sun, in the Temple of Vulcan, at Memphis. Its use, both externally and internally, as a medicine, is frequently mentioned by Celsus, and several other early authors; and the *Vytians*, the native practitioners of India, order it in cases requiring cordials, and externally, mixed with lime juice, as a repellent.

consumption; but it is only by the use of the entire gum-resin, in the latter stages of that intractable disease, that it can, in any way, prove beneficial. Myrrh in this case acts as a Tonic, and stems, in some degree, the progress of that exhaustion which always accompanies purulent expectoration. For the same reason, it proves beneficial in chlorosis, and defective excretion of the menstrual discharge, in pale, leucophlegmatic, languid girls. In combination with oxide of zinc, Myrrh has been found an extremely beneficial Tonic in a peculiar cough which occasionally accompanies pregnancy, and continues after abortion. Upon the whole, I may assert that Myrrh possesses tonic powers; but these can be taken advantage of only in cases where stimulants are admissible.

Myrrh may be administered in the form of powder, or in pills, in combination with other Tonics; or in the form of watery infusion; or the tincture may be given, if properly diluted. The oil, mixed with sugar as an oleo-saccharum, possesses all the properties of the entire drug. The dose of Myrrh in substance is from gr. x to ʒi; that of the tincture, from m. xxx to fʒi in fʒii of water; and that of the oil, from m. ii to m. xii. The watery emulsion is useless, being merely a solution of gum, slightly impregnated with a bitter.

INORGANIC SUBSTANCES WHICH OPERATE AS TONICS.

i. OXIDES OF METALS.

These are metals combined with certain proportions of oxygen, forming compounds which possess properties different from those of either metal or the oxygen. They are for the most part insoluble in water: those which are soluble display an alkaline reaction: they unite with each other, and enter into combination with acids, forming that class of substances termed salts; all of which, except those into which ammonia and the vegetable alkaloids enter, are composed of metallic oxides and an acid. Oxides of metals are arranged into two classes: the *first* class contains those oxides which are regarded as alkalies and earths; of which those medicinally used are *potassa*, *soda*, *lime*, *baryta*, and *magnesia*: the second, those which are neither alkalies nor earths; among which the

oxides of manganese, zinc, iron, antimony, bismuth, lead, and mercury, are medicinal agents. The metals forming these oxides are all capable of combining with oxygen in more than one proportion: thence the terms *protoxide*, *deutoxide*, and *peroxide*. If it were enquired—which of the components of these substances is the active principle, as far as regards the action of the oxide on the living body?—there would be no hesitation in affirming that oxygen, undoubtedly, is the efficient principle: pure metals are inert; oxygen, in the purest form in which we can obtain it, that of oxygen gas, is a powerful excitant. When oxygen is intimately united with a metal, the resulting compound is soluble in the animal fluids, and either enters into the circulation and is there decomposed, or exert a primary stimulant influence on the nerves of the part to which it is applied. In both cases it operates as a Tonic; but it is those oxides only which *exert a primary action on the stomach* that are now to engage our attention.

1. CALX. *Lime*. L. E. D.—This is a compound of calcium and oxygen: it is found most abundantly in combination with acids, forming mineral salts, in many parts of the world. It also forms a part of many vegetable and almost all animal bodies, constituting the solid part of bones, teeth, shells, crusts, horns, and nails: it is also found in hair and feathers, in muscles, and even in the medullary part of the brain. When calcareous spars, marble, and limestone, all of which consist chiefly of carbonate of lime, are exposed to a red heat, the carbonic acid is expelled, and pure lime remains.

Lime, or quick-lime, as it is termed, thus procured, is of a white colour, moderately hard, brittle, and porous. Its specific gravity is 2.3. Lime has been ascertained to be a compound of—

Calcium	. 71.42	or	1 prop. = 20
Oxygen	. 28.58	—	1 prop. = 8
	<u>100.00</u>	Equivalent	<u>28</u>

It is therefore a protoxide of the metal. This oxide, *Lime*, is inodorous, extremely acrid to the taste, displays distinct alkaline properties, and, when applied to the living body, enters into chemical union with its components, and corrodes and destroys the vitality of the part. It is one of the most

infusible of known bodies, and has a powerful affinity for water. When water is poured upon newly burnt Lime, it swells, becomes hot, and falls into powder; a large portion of the water is converted into vapour, whilst the rest disappears, having become an integrant part of the lime, which is now a *hydrate*, or a compound of Lime and water. It is this consolidation of the water, during which the latent caloric of the fluid is converted into sensible caloric, that is the cause of the heat extricated during this process, the *slacking* of Lime, and the origin of the additional weight of Lime after it is slacked. When the operation is performed on large quantities of Lime, in a dark place, light as well as heat are given out. Hydrate of Lime, or slacked Lime, is a compound of—

Lime .	75.68	or	1 prop. = 28
Water .	24.32	—	1 prop. = 9
	<u>100.00</u>		Equivalent 37

In this state Lime is soluble in water; and it is a curious fact, that cold water dissolves more than hot water. One pint of water, at 32° Faht. dissolves eleven grains of pure slacked Lime; at 60°, 9.7 grains; at 212°, it dissolves 5.6 grains only. It is in solution that Lime produces a tonic effect when taken into the stomach.

The solution of lime, or *lime water*, is prepared by agitating slacked Lime with water, and then setting the mixture aside in a well-stopped bottle until the undissolved Lime subside, and then carefully decanting the clear fluid. Lime water is limpid, inodorous, and has an alkaline, harsh, but sweetish taste. It converts vegetable blues to green; unites with oil, forming an imperfect soap; and, when exposed to the air, rapidly absorbs carbonic acid, and is again converted into Carbonate of Lime. It precipitates many of the astringent vegetable infusions and decoctions, is precipitated by oxalic, citric, and tartaric acids, by the alkaline carbonates and borates, and by almost all the metallic salts. These substances, therefore, are incompatible in prescriptions with lime water. But although lime water is precipitated by carbonic acid and substances yielding it, yet the carbonate of Lime thus thrown down is soluble in an excess of carbonic acid. For the same reason, although sulphuric acid precipitates lime from

a strong solution, yet, in a dilute solution, no precipitation is produced.

Lime, in its state of solution in water, is a Tonic of very moderate power; and it is probable that even this is due to its exerting a sedative influence on the nerves of the stomach, by which the irritability of the viscus is allayed; and the gastric juice, being more slowly secreted, is consequently more perfectly formed, and chymification thus aided. It is employed in those cases of dyspepsia in which there is a superabundant acidity of the stomach: in these instances its operation is not, as generally supposed, chemical, but such as has been just described. The old custom of combining bark with Lime water was founded on erroneous principles; and it is questionable whether the combination of Lime water with sarsaparilla be more consistent with sound practice. Lime water may be administered in doses of from two to four fluid ounces, twice or three times a day. The best adjunct is milk.

2. ZINCI OXYDUM. *Oxide of Zinc*. L. E. D.—Metallic Zinc is rapidly oxidized when it is thrown into a crucible heated to a white heat: the metal burns with a brilliant bluish-green flame, and emits white flakes, which, collected in a crucible inverted over the former, are Oxide of Zinc. The London College orders it to be prepared by decomposing sulphate of Zinc by ammonia; but much attention is required in precipitating the sulphate, as the Oxide is soluble in an excess of the solution. The Oxide, in whatever manner it is prepared, is a white, inodorous, tasteless substance, insoluble in water, but partially soluble in solutions of the pure alkalis, although not in their carbonates, and soluble also in almost every acid, forming regular salts. It consists of—

1 prop. of Zinc	= 34,	or	81
1 prop. of Oxygen	= 8		19
Equivalent	42		100

Oxide of Zinc, prepared in either way, is a protoxide of the metal. It was introduced into practice by Gaubius; and, although it has not fully realized all which that distinguished physician anticipated, yet it is a Tonic of much value. By the tonic influence which it exerts in the decline of acute diseases of a spasmodic character, it has been found beneficial in hoop-

ing-cough, for example, when the cough is kept up by custom, acting on a debilitated, irritable habit of body. The solubility of the Oxide, in an excess of the pure alkalies in solution, is of advantage in prescribing it in that weakened state of the digestive organs which induces psoriasis and some other cutaneous eruptions. In these cases, whilst the alkali allays the morbid irritability of the stomach, the Oxide of Zinc restores its tone.

Mr. Phillips recommends a carbonate of Zinc to be prepared by precipitating the sulphate by means of the carbonate of potassa. This would undoubtedly be a more economical preparation; but it is probable that it would be less active than the oxide: it is, however, worthy of a trial.

k. ARSENICUM. *Metallic Arsenic*.—Arsenic, like all other metals, exerts no influence on the animal economy in its metallic state. It is one of those metals which is capable of forming with oxygen a compound possessing acid properties. The following is one of these:—

ARSENICUM ALBUM SUBLIMATUM. *Sublimed White Arsenic*. L. E. D. Syn. *Arsenious Acid*.—When metallic Arsenic is heated, with free exposure to air, it is changed into arsenious acid; and the same substance is produced by digesting Arsenic in nitric acid, which is decomposed and yields its oxygen to the Arsenic. On a large scale, Arsenious Acid is obtained during the roasting of the native arseniurets of cobalt for the preparation of zaffre, and from the reduction of the arseniurets of copper. It undergoes a second sublimation to purify it, and is thus formed into white cakes, which are generally transparent in the inside, white and opaque on the surface, and break with a conchoidal fracture. In this state it is sufficiently pure for medicinal purposes, although the London College order it to be again sublimed in close vessels.

Arsenious Acid, the oxide of Arsenic, or white Arsenic, as it is commonly called, is volatile at a temperature of 383° : in this state it is inodorous; but, if it be placed on red-hot coals, it exhales the odour of garlic, owing to its partial reduction to the lowest state of oxidizement. It requires nearly 400 parts of cold water to dissolve one part of Arsenious Acid; but the solubility of the acid, in its transparent and

opaque state, is different: 1000 parts of boiling water take up 97 parts of the transparent acid, and retain 18 parts when cold; but the same quantity takes up 115 parts of the opaque variety, and retains 29 on cooling. This is an important fact in a practical point of view. Its solution feebly reddens the vegetable blues; and, when it is evaporated, the arsenious acid crystallizes in regular tetrahædrons. It is soluble, in small quantity, in alcohol and in oil, and readily unites with salifiable bases.

It has been asserted that arsenious acid was known to the ancients, as the word *Arsenikon* is mentioned by Dioscorides; but whether this was arsenious acid, which is first met with by the name *Arsenic* in the writings of Avicenna, it is not easy to determine. The first process for obtaining it is detailed in the Pharmacopœia of Schroeder, published in 1649; but it was not until the beginning of the eighteenth century, when Mr. Brandt, a German chemist, examined the metal and ascertained its affinities, that the nature of arsenious acid was well understood.

Transparent arsenious acid becomes opaque when exposed to the air—a circumstance which is ascribed to its attraction for water. It is a compound of 70.37 of Arsenic, + 29.63 of Oxygen, in 100 parts; or 1 prop. of Arsenic = 38, + $1\frac{1}{2}$ prop. of Oxygen (8×2) = 12; making the equivalent 50. For medicinal use, the white Arsenic sold in powder should never be employed, as it is generally adulterated with sulphate of lime—a fraud easily detected by exposing the powder to a heat sufficient to volatilize the arsenious acid.

Arsenious acid is decomposed by various reagents. It is precipitated from its aqueous solution by lime water in the form of a white powder, which is an arsenite of lime; by sulphuretted hydrogen as a sulphuret of Arsenic; by ammoniacal nitrate of silver, which throws down a yellow arsenite of silver; by the solution of cuprum ammoniatum, which throws down arsenite of copper, or *Scheele's green*; and, lastly, by metallic copper, in which case an alloy of the copper and the metallic Arsenic takes place.

Arsenious acid, or oxide of Arsenic, as it is called, has a most powerful action on the animal economy; but, when the

dose is properly apportioned, it is a valuable and sufficiently manageable Tonic in intermittents and other diseases requiring the aid of this class of remedies. It has long been employed in the fenny districts under the name of "tasteless ague drop;" but there are objections to it which have almost superseded its employment; and it should be recollected, that, if arsenical oxides or salts are to be employed, those forms of administering them ought to be preferred which are attended with the least risk, and the dose of which is most easily apportioned. Now, the arsenious acid, from the variations in its solubility, cannot be administered in solution without some risk.

1. METALLIC SALTS.—These are combinations of alkalies, or of oxides of metals and acids. Those medicinally employed are solids and assume regular crystalline forms.

Salts vary in colour, are inodorous, except carbonate of ammonia, more or less sapid when soluble, and insipid when insoluble. They differ greatly in their affinity for water; some being *deliquescent*, or attracting moisture from apparently dry air sufficient to dissolve them; some undergoing this change only in a very humid air; and others suffering nothing even in an atmosphere loaded with aqueous vapour: thence salts differ in solubility. But this depends also, in some degree, on their cohesion; their solubility being in the inverse ratio of this property. Soluble salts crystallize when their solutions are evaporated: the regularity of the crystals is greater the more slowly evaporation is conducted; and these always assume the same definite forms, all circumstances being equal. All salts, in crystallizing chemically, unite with a definite portion of water: when this is lost spontaneously, on exposure to the air, the salt is termed *efflorescent*; when it retains the water of crystallization, *persistent*; when heat is applied, and it dissolves in this water, the salt is said to undergo the *watery fusion*.

Amongst the salts now under consideration, some are formed from protoxides or oxides containing one equivalent of a metal and one equivalent of oxygen; others from peroxides: thence the appellations *proto* and *per* are attached to the names of the salts.

1. ARSENITE OF POTASSA.—This is a compound of Potassa and arsenious acid, in the proportions of one equivalent of each of the components. It is characterized, like other arsenites, by forming a yellow arsenite of silver when mixed with a solution of the nitrate of silver; and by forming orpiment when, after being acidulated with acetic acid, a stream of sulphuretted hydrogen gas is passed through it. Arsenite of Potassa is the active part of the following preparation.

LIQUOR ARSENICALIS. *Arsenical Solution.* L. D. *Solutio Arsenicalis.* E.—This solution was introduced as a remedy for ague, by Dr. Fowler, of Stafford, in 1786, under the name of Solutio Mineralis. In the preparation of the Pharmacopœias there is scarcely a sufficient quantity of the Potassa to saturate the whole of the arsenious acid. Each fluid drachm of the solution contains a grain of the arsenite, or half a grain of arsenious acid; consequently, the dose of eight minims, that generally commenced with, contains nearly 1-16th of a grain. In this dose, gradually increased, if necessary, to forty or fifty minims, the arsenical solution has been advantageously administered, as a Tonic, for the cure of intermittents; but it must not be supposed that it will always succeed where other means fail; and, indeed, it is not easy to explain the manner in which it produces its beneficial effect, as it sometimes induces symptoms at variance with our notions of those which follow the exhibition of a Tonic, and yet it cures the disease. Were I to hazard an opinion as to the mode in which arsenious acid and the arsenite of potassa cure intermittents, I should regard them as acting by their primary effect as stimulating Tonics on the stomach, assisting the digestive powers of that viscus; and, consequently, both by that effect and also by the extension of their tonic influence to the whole system, removing the debility which favours the repetition of the intermittent paroxysm. Their diaphoretic power may, also, aid their curative influence in intermittents; as it is well known that many substances which have no other power than that of increasing perspiration, and consequently diffusing the blood equally over the system, cure agues.

The Arsenical Solution has been given, with benefit, in those cases of chronic rheumatism which assume an inter-

mittent type: it has also proved occasionally useful in symptomatic epilepsy, chorea, and other spasmodic affections, as well as *tic douloureux* and *cephalalgia*. I have had much experience of its efficacy in lepra and some other cutaneous diseases, when given in conjunction with large doses of the pure alkalies and with conium.

In the treatment of cancer, arsenious acid has been both internally administered and externally applied; but I must confess that I have never witnessed decided benefit from its administration, although I have seen its deleterious agency manifested in many cases, even where its use was confined to the surface. When applied to an external wound, it sometimes causes, almost immediate, inflammation of the stomach, accompanied with violent vomiting and purging; and death is as likely to ensue as if it were internally administered. Whether, in this case, the acid is absorbed into the circulation, or the stomach is affected by sympathy, through the medium of the nerves, is still undetermined; but the probability is that it is taken into the circulation, and acts directly on the organ, in the same manner as if it were taken by the mouth, in which there is no doubt that it enters the circulation. We have only, however to consider its acrimony as an external application, to be satisfied that it exerts, also, an immediate and direct influence on the nerves of the stomach, when it is taken into that viscus. Upon the whole, therefore, although arsenious acid and its preparations, when properly administered, often afford all the advantages which can be expected from the operation of the most powerful and safe Tonics; yet, much caution is requisite in using them under every circumstance.

When an overdose of arsenious acid or of arsenite of Potassa is swallowed, the first symptoms are violent pain in the stomach, and, soon afterwards, in the bowels also, accompanied by a sensation of heat and constriction in the œsophagus and the mouth, producing nausea with an increased excretion of saliva. These feelings are conjoined to a sense of tightness of the skin of the face, stiffness of the eyelids, inflammation of the conjunctiva, and an itching of the face and neck. Vomiting is sometimes incessant, the fluid brought up is streaked with blood: there is purging, and occasionally a paucity of

urine, and even strangury: the pulse, which is at first indicative of high inflammatory action, quickly sinks, and becomes irregular; cold sweats supervene, with convulsions, and death ensues. In those cases, in which the poison has either been ejected by vomiting or removed by the stomach pump, the wretched sufferer, although he escape the blow which threatened him, yet, seldom fails to suffer during the remainder of his life, pining with paralysis and both mental and bodily debility.

The post-mortem examination of the body of a person poisoned by arsenic exhibits remains of inflammatory action in the stomach, generally confined to the mucous membrane, which is red, soft, pulpy, and easily detached; but there is often a thinning of the whole coats. In addition to this condition of the viscus, there is often a highly injected state of the vessels, with spots of extravasated blood; yet these appearances are scarcely sufficient to account for the severity of the symptoms. From this circumstance, and the fact that the inflammation of the stomach is more severe, and the death more sudden, when the acid or the arsenite is applied to a wound on the surface than when it has been swallowed, it is supposed that the fatal issue is not the result of the local action of the poison on the stomach. Several ingenious experiments of Mr. Brodie seem to confirm this opinion, and to lead to the conclusion, that death from poisoning with arsenic is to be ascribed to the influence of the arsenical salt upon the heart and the nervous system. The decided change, however, which it produces upon these is sufficient evidence of the energy of its local influence.

In such cases, undoubtedly, the first object is to free the stomach from the poison as completely and as quickly as possible. The means of effecting this, most readily and effectually, is the stomach pump, which should be promptly used; and I am of opinion that, if the nature of the poison be known, and even when subsequent experiments are likely to be instituted on the contents of the stomach, in using the pump, lime water should be employed to wash out the stomach instead of common water. The union of lime and arsenious acid forms a nearly insoluble salt; so that, even

whilst we are relieving the viscus of its deleterious contents, we are, by this practice, also diminishing the virulence of any part of the poison which may still remain. When, however, the stomach pump is not in the way, those emetics should be selected which do not favour the function of absorption: the sulphates of zinc and of copper, for instance, which act directly upon the stomach, and not through the medium of the circulation. In this case, also, lime water should be drunk immediately after the first act of vomiting, to neutralize and diminish the activity of the arsenious acid in the stomach. It might be supposed that the lime water, in this instance, should be administered in a tepid state; but it must be recollected that the solubility of lime is in the inverse ratio of the temperature of the water; and, therefore, by heating the lime-water, we produce the deposition of a certain quantity of the lime, and thereby diminish its influence in neutralizing the arsenious acid. The advantage of this union of the lime with the arsenious acid depends on the nearly insoluble nature of the compound; for although the arsenite of lime be not wholly insoluble, yet it is less so than arsenic; and, consequently, its activity being in the direct ratio of its solubility, the formation of this salt in the stomach, by the introduction of lime water into that viscus, in cases of poisoning by arsenic, is a safeguard, to a certain extent, against the acrimony of the arsenious acid. As there is hazard, should the arsenical salts be absorbed, we must be particularly cautious not to dilute with any fluid that is likely to act as a solvent of arsenious acid; such, for example, as alkaline solutions, which have been recommended in these cases; the alkaline arsenites being very soluble and as poisonous as the arsenious acid itself. Oil may be safely and advantageously administered, and also milk. This effect of oil is indeed so well known, that the smelters of metallic ores containing arsenic, in Cornwall, whenever they are infested with more than an ordinary portion of arsenical vapour, have frequent recourse to olive oil; and we are informed by Dr. Paris that an annual sum is allowed to the workmen by the proprietors of smelting houses, in order that it may be constantly supplied.

From what has been said regarding the effect of Arsenic on

the stomach, and also regarding the probability of its absorption, little benefit can be expected from the employment of antidotes. It has been recommended to use vinegar; but the solubility of arsenious acid in vinegar renders this a dangerous agent instead of its being an antidote; the sulphuret of potassa merits no better confidence, the sulphurets of arsenic being poisonous; and, indeed, if we except lime water, which I have already noticed as forming a nearly insoluble compound with arsenious acid, I know of nothing which has the smallest claim to the title of antidote in cases of poisoning by arsenic. Magnesia has been recommended: but magnesia is not acted upon by the arsenious acid. A solution of the acid, boiled in magnesia for some time, remains unaltered: thence magnesia can produce no effect as an antidote. It is of great importance, after evacuating the stomach, to allay the excitement which has been induced on its coats; and this is most effectually done by blood-letting; counter-irritation, as, for instance, blistering, by means of boiling water on the scrobiculus cordis; and sheathing the organ itself by the administration of oil and milk. When the inflammatory symptoms are reduced, the case is to be regarded as one of disease, in which the stomach has been the seat of inflammation, without any reference to the exciting cause.

2. ZINCI SULPHAS. *Sulphate of Zinc*. L. E. D.—This is a compound of sulphuric acid with the protoxide of zinc, and a large proportion of water of crystallization. Sulphate of Zinc was first artificially made in the sixteenth century, by Henkel and Newmann, two German chemists, who prepared it from calamine and blende, nearly in the same manner as it is now manufactured for commercial purposes, at Ramelsbery, near Goslar, and other places. The ores are roasted and thrown, whilst they are yet hot, into water, which is afterwards evaporated in leaden boilers, and then exposed in wooden cisterns to crystallize. In this process, the sulphur contained in the ores is partly converted into sulphuric acid, which aids the metal to decompose the water, the oxygen of which it attaches to itself, so as to form it into an oxide, which unites with the sulphuric acid, and forms the sulphate. The Sulphate of commerce is unfit for the purposes of medicine;

and, therefore, the Pharmacopœias order it to be formed by the direct combination of its constituents. The salt obtained is pure and in its crystalline state.

The Sulphate of Zinc thus procured, although strictly neutral, yet is an acidulous salt; it has an acrid, styptic taste; is inodorous and is colourless, transparent, flattened, quadrilateral crystals, which effloresce in the air; and, when exposed to heat, first lose their water of crystallization, then their acid, if the temperature be much augmented; and the simple oxide remains. Sulphate of Zinc is soluble in little more than two parts of water at 60°, and in its own weight of boiling water. The solution is precipitated by the alkalies and their carbonates; but the pure alkalies in excess redissolve a portion of the oxide which is thrown down: it is also precipitated by muriate, nitrate, and acetate of baryta, and acetate of lead; the precipitates being sulphates of baryta and of lead, whilst a muriate, nitrate, and acetate of Zinc remain in solution. These substances, therefore, are incompatible in prescriptions with Sulphate of Zinc. With sulphate of potassa it forms a double salt, which crystallizes in flat, rhombic prisms; and this compound salt is extremely useful where a tonic influence is required to be conjoined with an aperient. The composition of Sulphate of Zinc, in its crystalline state, is—

Oxide of Zinc	30.9	or	1 prop.	= 42
Sulphuric Acid	29.4		1 prop.	= 40
Water . . .	39.7		7 prop.	= 63
	<u>100.0</u>		Equivalent	145

As a Tonic, Sulphate of Zinc exerts its primary influence on the stomach; the effect produced there being communicated by nervous energy to the rest of the system. It is supposed to operate with less general excitement than the other metallic salts, and, therefore, is frequently prescribed in phthisis. To its general tonic influence, also, may be ascribed its efficacy in the humid asthma of old men; for, by communicating tone to the exhalant vessels of the bronchia, it diminishes both the acrimony and the quantity of the bronchial excretion, and renders the expectoration of the remainder more easy. The same mode of action enables this Sulphate to prove useful in protracted hooping cough, in which the habit

is much debilitated. The dose of the Sulphate of Zinc, when its tonic effect only is desired, should not exceed gr. ii, repeated twice or three times a day. It may be given in combination with all the mineral acids; and also, as I have already stated, with the pure alkalies; and with such of the bitter infusions as contain little tannin.

3. ZINCI ACETAS. *Acetate of Zinc*. E. D.—This salt may be prepared by the direct combination of its constituents; but in the Pharmacopœias it is directed to be obtained by mixing the solution of the acetate of lead with a solution of sulphate of zinc; a double decomposition takes place, the oxide of zinc detaches itself from the sulphuric acid to combine with the acetic, leaving the lead in conjunction with the sulphuric acid, so as to form an insoluble sulphate, which precipitates. By filtering and evaporating the liquid, the Acetate of Zinc is procured in talcy crystals, soluble in water, and readily decomposed by heat. The constituents of this salt, are 1 prop. oxide of zinc = 42, + 1 prop. acetic acid = 50, + 7 prop. of water (7×9) = 63, making its equivalent 155.

Acetate of Zinc possesses the same tonic properties as the sulphate; but it is seldom prescribed as an internal remedy. It is more frequently used as an astringent collyrium in ophthalmia.

4. CUPRI SULPHUS. *Sulphate of Copper*. L. E. D.—This salt is found abundantly in a state of nature, occasionally solid, massive, or in capillary or cubic crystals, but more generally in solution in water, in the vicinity of copper mines. It is also obtained by roasting the native sulphurets of copper, and treating them in the same manner as the sulphurets of zinc for the preparation of the sulphate of that metal. It is known in commerce by the names of *blue vitriol* or *blue copperas*, and is a bisulphate. It is purified by redissolving the blue vitriol and crystallizing. The form of its crystals vary according to the manner in which the process is conducted; but, in general, they are either octahedrous or decahedrous, with the edges truncated at the base; and refracting double.

Sulphate of Copper is inodorous and has a strong styptic taste. It is soluble in four parts of water at 60° Faht., and in two parts of boiling water. It is insoluble in alcohol.

When long exposed to the atmosphere, it undergoes a slight degree of efflorescence, so that its surface becomes covered with a whitish-green powder. In a moderate heat it loses its water of crystallization, and in a high temperature is decomposed, the acid being driven off, whilst a black oxide of copper remains behind. According to the analysis of Berzelius, the pure Sulphate consists of—

Sulphuric Acid	. 31.38	or 2 prop. $(40 \times 2) = 80$
Peroxide of Copper	32.32	1 prop. = 80
Water	. . . 36.30	10 prop. $(9 \times 10) = 90$
	<u>100.00</u>	Equivalent <u>250</u>

Sulphate of Copper is decomposed by alkaline solutions; by lime water; the hydrosulphurets; subborate and phosphate of soda; the salts of lead; muriate and acetate of baryta; the nitrates of lime, mercury, and silver; and astringent vegetable decoctions and infusions. It is also precipitated copiously, and of a reddish-purple colour, by ferro cyanate of potassa.

Sulphate of Copper is a powerful but hazardous Tonic and antispasmodic. It has, however, been given in doses of from half a grain to one grain in spasmodic diseases, in combination with opium, twice or three times a day: but, unless the disease be accompanied with severe diarrhœa, as Asiatic cholera, in which it has proved successful, it is not to be recommended. In chronic diarrhœa nothing is more likely to check the discharge and to increase the tone of the habit than Sulphate of Copper, in doses of gr. ss, combined with gr. i or gr. ii of opium. It has been supposed to operate in these cases by its astringent powers; but the dose is too minute to support this opinion; and it is more probable that it acts as a Tonic on the nerves of the intestines, and thus, by increasing their tone, the excretion is diminished. It is on this principle that it has lately been advantageously employed in diarrhœa, a disease depending on a weakened state of the coats of the intestines. The dose of the sulphate, as a Tonic may be gradually extended to gr. ii, but ought not to exceed this quantity.

5. *ÆRUGO. Subacetate of Copper, L. E. D. CUPRI ACETAS, Acetate of Copper, D. Syn. Verdigris. Distilled Verdigris.*

The first of these substances is prepared at Montpellier in France*, by stratifying plates of copper with the fermenting marc of the grapes from the wine presses : the copper is thus first oxygenated, and the oxide, uniting with acetic acid of the fermenting husks and stalks, forms an impure subacetate of copper, or rather a mass of mixed acetates. It is also prepared at Grenoble, by simply moistening copper-plates with distilled vinegar, until the surface be oxygenated and converted into Verdigris. This preparation is usually obtained in a dry, hard, pulverulent, foliaceous, pea-green mass. Distilled water dissolves 0.56 parts only of the crude Verdigris, which consist of soluble binacetate of copper, composed of 1 prop. peroxide of copper = 80, + 2 prop. acetic acid = 100, making the equivalent 180 : the insoluble portion is a diacetate, and consists of 2 prop. of the peroxide = 160, + 1 prop. of acid = 50, making the equivalent 210.

The second preparation, the Acetate of Copper, is formed by dissolving Verdigris in distilled vinegar or diluted pyroligneous acid, decanting off the solution and crystallizing by evaporation. The crystals are very deep-green rhomboids, efflorescent in the air, and becoming, when exposed to it, of a light bluish-green hue ; they are entirely soluble in water, but not in alcohol or ether. They consist of 2 prop. of peroxide of copper = 160, + 1 prop. of acetic acid = 50, and 2 prop. of water = 18, making the equivalent 228.

These salts of copper possess the same tonic powers as the sulphate. When the salts of copper have been taken in poisonous doses, violent vomitings and pains of the stomach and intestines follow : there is a distinct coppery styptic taste in the mouth, and a sensation of strangulation in the throat, colic pains, sometimes purging, with severe tenesmus, and occasionally the alvine discharges are bloody : these symptoms are followed by violent headache, vertigo, cramps, and convulsions ; and, if the poison be not wholly expelled from the stomach, inflammation of the mucous membrane supervenes, and death rapidly follows. To relieve these symptoms, the first thing to be done is to evacuate the stomach, by means of the stomach pump, and to reduce the excitement by bleeding.

* London Dispensatory, 6th edition, art. Cuprum.

Orfila and others advise to give as much albumen and *sugar* as the patient can swallow. The sugar and albumen, in this case, are supposed to reduce the salts of copper, at least to alter them so much that they lose their acrimonious and poisonous qualities; but this is doubtful. If sulphate of copper be boiled in a solution of sugar, it appears to be reduced to the metallic state; but it requires to be boiled. These substances, however, are usually employed in cases of poisoning by salts of copper.

BISMUTHI SUBNITRAS. *Subnitrate of Bismuth.* L.—This tonic salt is a compound of the oxide of Bismuth, water, and a small proportion of nitric acid. As a Tonic, it has of late years been much employed. It is never found in a natural state. Bismuth dissolves readily in nitric acid moderately diluted with water; and when this acid solution is poured into a large quantity of water, a snow-white precipitate occurs, which, separated by the filter and dried, is the Subnitrate of Bismuth. It is a white, inodorous, tasteless, flaky substance, soluble in the acids and the pure alkalies. It is blackened by sulphuretted hydrogen and its compounds. It consists of 3 prop. of protoxide of Bismuth (84×3) = 240, + 1 prop. nitric acid = 54, making the equivalent = 294.

This preparation is a powerful Tonic, and particularly useful in that state of stomach which produces *pyrosis*. In this complaint, the paroxysms commence with a sense of constriction and pain at the stomach, which gradually subsides after the eructation of a large quantity of watery fluid, either perfectly insipid or acidulous. The Subnitrate, in doses of from gr. iii to gr. x, in combination with gr. i of opium, gives almost immediate relief, and affords a more decisive evidence of the primary action of tonics on the stomach than any Tonic of this class. It has been stated to be a valuable medicine in cholera; but experience has demonstrated the error of this opinion.

BARYTÆ MURIAS. *Muriate of Baryta.* E. D.—In strict chemical language, this salt is a muriate only when it is dissolved in water, or when it exists in crystallization with much water. It is prepared by dissolving the carbonate in muriatic acid, diluted with three parts of water, and crystallizing the

solution. The carbonate was first found native in 1783, by Dr. Withering, after whom it was named Witherite. Its crystals assume different forms; but in general they are in hexagonal prisms. The carbonate has no sensible taste nor odour, yet it is a virulent poison. The muriate, or rather hydrochlorate of Baryta, generally crystallizes in flat rectangular plates with bevelled edges, which are permanent in the air: it has a peculiar, pungent, nauseous taste, and is soluble in two and a half times its weight of cold water. According to Berzelius, it consists of 1 prop. of Muriate of Baryta = 115, + 9 prop. of water (9×9) = 81, making the equivalent 196.

Hydrochlorate of Baryta is decomposed by alkaline phosphates, and an insoluble phosphate is formed, which exerts no influence on the animal body; by the sulphates, also, forming insoluble, and consequently inert sulphates of Baryta; and by the citric acid forming with the Baryta a flaky precipitate, which gradually assumes the character of a beautiful and brilliant vegetation. The citrate is partially soluble, and, therefore, like all the soluble salts of Baryta, is poisonous. From the effects of these reagents, it is obvious that they are incompatible in prescriptions with the Muriate of Baryta. Neither can this Muriate be administered with astringent vegetable infusions, an insoluble tannate being produced. The solution of the hydrochlorate, in three parts of water, is employed as a Tonic. It is chiefly administered in scrophula, and is ordered in doses of three to six minims, in a glass of water or an infusion of quassia. It was first recommended in this disease by the late Dr. Crawford; but it is not a powerful Tonic in scrophula. It has been also used in asthma, particularly in those cases in which there is a tendency to hydrothorax; in these the diuretic influence of the Muriate, aiding its tonic power, is likely to be useful; but I cannot state any opinion, either favourable or adverse to its employment.

In large doses, the hydrochlorate of Baryta is an acrid poison, destroying not only the powers of the stomach, but extending its action to the heart, rendering that organ insensible to the stimulus of the blood. As the salt is decomposed, and insoluble compounds are formed by sulphuric acid and the

alkaline sulphates, the soluble phosphates and tannin, these are the proper remedies to be administered as antidotes in poisoning by Muriate of Baryta.

B. SUBSTANCES OPERATING AS TONICS THROUGH THE MEDIUM OF THE BLOOD.

All the tonic substances which have been noticed exert a primary action on the stomach, and a secondary influence on the system through the nerves: those now about to be examined enter the circulation, and can be detected in the secretions. This division of the class, besides containing substances which owe their influence on the animal œconomy to oxygen, contain others which derive it from chlorine. Both are deserving of attention.

m. FERRI OXYDUM NIGRUM. Black Oxide of Iron. E. D. Syn. *Æthiops Martialis*.—There are two Oxides of Iron—a protoxide, consisting of 28 parts, or 1 prop. of iron, + 8 parts, or 1 prop. of oxygen, making the equivalent 36; and a peroxide, consisting of 28 parts or 1 prop. of iron, + 12 parts, or 1½ prop. of oxygen, making the equivalent 40. The substance under consideration is a mixture of both these oxides, united in irregular proportions. It is formed when iron is heated to redness in the open air, as in the operations of the anvil, and when it is brought into contact with aqueous vapour at a high temperature. The small scales from the anvil are ordered, in the Pharmacopœias, to be separated by the magnet and powdered; and these form the preparation under notice.

The Black Oxide prepared in the above manner is of a black colour; it soils the hands, is insoluble in water, but soluble in acids, without exciting effervescence. The reason why it is an irregular, mixed oxide, has been thus explained by M. Mosander: a bar of iron, when heated in the open air, affords a layer of oxide on the surface, which contains more oxygen considerably than the layer beneath it; the former is supposed to contain one proportion of peroxide to two proportions of protoxide: the latter, one of peroxide to three of protoxide. The outer layer is always variable in its composition; the inner is generally uniform.

As a Tonic, this mixed oxide has been at one time highly extolled, at another altogether neglected. In the state of an oxide, Iron dissolves in the gastric juice, acts directly upon the nerves of the viscus, and through them upon the general system. The influence of this oxide as a Tonic is less quickly obvious than that of the saline preparations of Iron; therefore it is well adapted for the treatment of those cases of general debility, in which the tonic effect is not required to be quickly produced, but where a permanent effect is expected. This oxide is a better preparation than the filings of Iron, which gain their activity from meeting with acid in the stomach; thence the inconvenience which follows their use, the oxygenation of the metal in the stomach producing a decomposition of the water of its aqueous contents, and causing the evolution of much hydrogen gas. The utility of the black oxide is, also, increased by its meeting with acid in the stomach, so as to favour its solution, and consequently its absorption into the circulating mass. The dose of the Black Oxide is from gr. v to ʒi: it may be combined with any aromatic. Its influence is known to be in operation by the black colour of the alvine discharges.

n. ACIDUM SULPHURICUM. *Sulphuric Acid.* L. E. D. Syn. *Oil of Vitriol.*—This is a compound of sulphur, oxygen, and water. The dry acid or anhydrous acid which it contains is a combination of Sulphur 1 prop. = 60, + Oxygen 3 prop. $(8 \times 3) = 24$; making the equivalent 40. The liquid acid, of a specific gravity of 1.847, which is the usual gravity of what is termed the concentrated acid, contains—

Anhydrous Acid 1 prop. = 40,	or	81.6
Water 1 prop. = 9		18.4
Equivalent 49		100.0

It is a colourless, transparent, heavy fluid, resembling water to the eye, but having the consistence of oil. It is inodorous, and has an intensely acid taste; but it is so acrid that it cannot be applied to the tongue with safety in the undiluted state. In the concentrated state, it speedily chars all animal and vegetable bodies, and has so great an affinity for water, that, when exposed to the air, it imbibes one third of its weight of water in twenty-four hours. When it is suddenly

combined with water, in the proportion of one part to four of the acid by weight, the density of the mixture is considerably less than that of the mean of the two components ; therefore much latent caloric is disengaged in a sensible form, raising the thermometer from 50° to 300° of Faht. and a great condensation takes place in cooling. Sulphuric Acid unites readily with the alkalies, earths, and most of the metallic oxides, and forms the salts known by the name of *sulphates*.

Free Sulphuric Acid is probably never found in nature, although M. Baldassari has published an account of his having discovered it in a solid, crystallized state in a grotto of Mount Amiata, below the baths of Saint Phillip. It is, however, found in an impure state in hollows near the craters of several volcanoes. Humboldt says that it is contained, in conjunction with hydrochloric acid, in the waters of the *Rio Vinagre*: Vauquelin, also, has detected it in the water of a mountain lake in the island of Java.

Sulphuric Acid may be artificially prepared by the direct combination of its components. Thus, if sulphur be burnt in oxygen gas, *over water*, this acid is formed, and is taken up by the water; but nearly all the liquid Sulphuric Acid, employed both in trade and in medicine, is manufactured by burning a mixture of eight parts of sulphur and one of nitre in leaden chambers containing water. In this process, the nitre is decomposed and aids the acidification of the sulphur. The process is carried on until the water is highly charged with the acid; after which it is concentrated by evaporation, and forms the Sulphuric Acid of commerce. The Sulphuric Acid of commerce generally contains some sulphate of lead and sulphate of potassa; but, as the acid is always diluted for medicinal use, this is of little consequence, the sulphate of lead being thrown down, in the form of a white powder, on the addition of the water to form the diluted acid.

Sulphuric Acid, when properly diluted, is a Tonic of very considerable power. Its influence is extended, through the circulation, to every part of the system. It is much used in continued fevers, especially those in which the debility is so great as to admit of the escape of blood from the intestinal vessels; and it is the only remedy, in conjunction with wine,

on which we can rely in the confluent smallpox, when the pustules are filled with a bloody sanies and the urine is coloured by broken-down particles of blood. In a general point of view, we may safely consider it proper to be administered in all those fevers accompanied with extreme debility, and what has been termed a putrid tendency in the habit. In cases of immoderate perspiration—as, for instance, in the hectic of phthisis pulmonalis—it is the appropriate remedy; and, in combination with aromatics, it removes many of the urgent symptoms of dyspepsia; and is altogether a Tonic of the highest value when judiciously employed. In administering it, however, even in the diluted state, some anomalous effects occur which should be retained in remembrance. Thus, when given to women who are suckling, it acts powerfully on the system of the infant, causing gripings, and frequently convulsions, although it has never been detected in the milk of the mother:—a fact illustrated by the following quotation from a case, extracted from a German Journal, which appeared in the Medical Gazette of May the 10th, 1828. A woman poisoned herself with concentrated Sulphuric Acid. “The last efforts of Nature were exerted to give birth to a child, in whom, upon examination, Sulphuric Acid was detected in the cavity of the pleura and the peritoneum, and also in the heart and bladder. Its presence was also ascertained in the liquor amnii.

Sulphuric acid, in its diluted state, consists of a fluid ounce and a half of the strong acid and four fluid ounces and a half of distilled water; thence, each fluid drachm contains ten minims of the strong acid. It is given, in combination with vegetable infusions and decoctions, in doses of from eight to thirty minims to produce its tonic influence. It cannot be combined in prescriptions with muriate of lime, lime water, barytic water, or the solution of acetate of lead, or muriate of baryta; insoluble compounds being produced by these combinations.

If the strong acid be taken into the stomach, it operates as a corrosive poison; producing violent pains of the stomach and chest, and a burning sensation in the mouth and throat, at the same time that an icy coldness is felt all over the body.

In this case, no time must be lost, but magnesia, dissolved in water, freely and repeatedly administered; using the stomach-pump in the intervals between each dose. If magnesia be not at hand, any alkaline carbonate will answer equally well. It often happens that the poison is vomited almost as soon as it is taken; but the patient is not on this account secure, for he may still die of the corrosive effects of the acid. In a case which occurred at the Hotel Dieu, although the poison was instantly vomited, yet the stomach could not afterwards retain either solid or fluid aliment, however mucilaginous or mild; and the man died sixty days after having taken the poison. The stomach was contracted in an extraordinary degree: it was perforated on the anterior parietes; and the edges of the perforation had contracted adhesions with the concave surface of the liver: no extravasation had taken place; and the interior of the viscus presented numerous cicatrices of very recent date, but all completely formed.

ACIDUM NITRICUM. *Nitric Acid.* L. E. D.—Liquid Nitric Acid is a heavy, colourless fluid, emitting, when exposed to the air, dense, disagreeable fumes: its taste is intensely acid and corrosive; and, when applied to the skin, it tinges it of an indelible yellow colour, destroying the cuticle, which, in a few days, peels off. Its specific gravity is 1.513 to water as 1.000. It has a great affinity for water, and attracts it from the air; and, when water and the acid are suddenly mixed, heat is evolved. It frequently contains a little Nitrous Acid, which gives it a yellowish tinge; but, by heating the acid, this is driven off, and it remains colourless, unless it be exposed to the direct rays of the sun, when it is partially decomposed, oxygen is evolved, and, Nitrous Acid being formed, a yellowish tinge is communicated to the whole fluid. It is decomposed with great rapidity by some combustible bodies. It unites with oxides of metals and with alkalies, forming salts which are named nitrates.

Liquid Nitric Acid is a compound of anhydrous Nitric Acid and water, in the proportion to each other as 75 to 25; but this is the greatest strength of liquid Nitric Acid, its specific gravity being 1.5000. The anhydrous acid cannot exist except

in a state of combination with some salifiable base, as, for example, in nitrate of potassa. The elements of the anhydrous acid are—1 prop. of Nitrogen

$$\begin{array}{rcl} & & = 14 \text{ or } 26 \\ 5 \text{ prop. of Oxygen } (8 \times 5) & = & 40 \quad 74 \\ \text{Equivalent} & \quad \quad & \hline & \quad \quad & 54 \quad 100 \end{array}$$

But this state of the acid exists only in the nitrates: the acid of the Pharmacopœias consists of 1 prop. of Anhydrous acid = 54, + $1\frac{1}{2}$ of water = 13.5, making the equivalent 67.5.

For medicinal purposes, Nitric Acid is procured by distilling together two parts of dried nitrate of potassa and nearly two parts of sulphuric acid. The theory of the production of the Nitric Acid is simple: the affinity of the sulphuric acid for potassa is greater than that of the Nitric Acid; the sulphuric acid, therefore, when aided by a high temperature, breaks the affinities between the Nitric Acid and the potassa in the nitrate, a double decomposition takes place, the anhydrous sulphuric acid contained in the liquid acid employed combines with the potassa, whilst its water combines with the dry nitric acid of the nitrate, now set free, and passes over into the receiver in the state of liquid Nitric Acid. A bisulphate of potassa remains in the retort: a quantity of oxygen gas is generally evolved towards the end of the operation, and may be collected.

The acid thus procured, if the nitrate of potassa have been pure, contains no admixture except a little Nitrous Acid, which can be readily expelled. But the Nitric Acid of commerce always contains both sulphuric and muriatic acid: the first is detected by diluting the acid and adding a weak solution of nitrate of baryta; the second, the muriatic acid, is detected by adding a solution of nitrate of silver to the diluted acid. The proportion of these adulterations is ascertained by adding to a specific quantity of the suspected acid, largely diluted with distilled water, as much of the reagent as will precipitate the foreign acids; then drying the precipitate and weighing it. If the adulteration be muriatic acid, its quantity may be determined by the weight of the dried chloride of silver and the proportion of hydrogen necessary for forming the chlorine into hydrochloric acid: if the adulteration be sulphuric acid, the simple weight of the sulphate of

baryta obtained informs us of the proportion of the sulphuric acid existing in the nitric. Nitric Acid may be freed from these adulterations by slowly redistilling it. But a more certain method is to distil the acid from a small quantity of nitre to free it from sulphuric acid, and to drop into it as much nitrate of silver as will precipitate all the muriatic acid in the form of chloride of silver, before distilling to purify it from muriatic acid.

As a medicinal agent, Nitric Acid is never administered unless largely diluted: it is less powerful as a general Tonic than sulphuric acid, and it differs from it in undergoing decomposition in its passage through the circulation; operating, consequently, rather by affording oxygen to the system than as a tonic in its entire state. It possesses some advantages over sulphuric acid in those cases of dyspepsia which are accompanied with sickness and great irritability of the stomach, as it rapidly allays these symptoms. It is also admirably adapted for keeping up the tone of the system under the irritation of a mercurial course; as it does not interfere with, but rather favours the action begun by the mercury. For the same reason, it proves highly beneficial in alterative courses of mercurials in obstinate ulcerations of the legs, and in cases of impetigo. I have frequently administered the bichloride of mercury dissolved in Nitric Acid, without observing any inconvenience to result from the combination.

Nitric Acid, as I have already mentioned, can be administered only when largely diluted; and, therefore, to facilitate its administration, the London College orders the acid to be kept in a diluted state, in the proportion of one fluid ounce of the strong acid to nine fluid ounces of distilled water. The dose of this diluted acid is from $m. x$ to $m. xxx$ in $f\text{z}ii$ of water, sweetened with simple syrup. In this state it forms an agreeable potion, which is seldom objected to by patients, and which may be repeated every third or fourth hour. In cases of purpura, a disease attended with great debility, nothing facilitates the restoration of tone more than the liberal use of this potion. As an external, or topical Tonic, a lotion of the dilute acid, formed by adding $f\text{z}ii$ to $f\text{z}viii$ of water, is a useful application to old and indolent ulcers. The strength of

the lotion may be proportionate to the degree of stimulus which the sores require ; and, in half the strength, it forms a useful gargle in languid or indolent ulcerations of the tonsils.

It is incompatible in prescriptions with sulphate of iron, alcohol, and combustibles ; and all bodies decomposed by it, such as acetates of lead, of mercury, and of potassa ; and with muriatic acid, by its union with which both acids are decomposed, and a distinct compound nitro-muriatic acid, containing free chlorine, is the result. It is also improperly prescribed to be given in the form of drops, in conjunction with tinctures, particularly those containing volatile oils, for instance, lavender, cinnamon, and orange peel.

Nitric Acid, taken in a concentrated state, is a most virulent poison. The mucous membrane of the mouth becomes white, thickened, and slightly yellow in some places, and easily detached : the epidermis of the lips is separated from the borders of the mouth, generally in a semilunar form, as if the glass from which the poison was taken had left its mark upon the lips. The general appearance of the face indicates the utmost anxiety ; the pulse is small, scarcely perceptible ; and there is the same icy coldness of the surface, as in poisoning by sulphuric acid. The patient groans deeply, and complains of pains of the throat and the stomach ; he is afflicted with almost unceasing nausea and frequent vomiting ; and, notwithstanding the coldness of the surface, large drops of sweat stand upon the face and chest. If these symptoms be not relieved, death generally ensues within twenty-four hours after the poison has been taken.

The treatment of cases of poisoning by Nitric is the same as that required when sulphuric acid has been taken—the use of the stomach pump ; a mixture of magnesia and water ; mucilaginous drinks ; and, after the stomach has been emptied, bleeding, and the employment of counter-irritants.

p. METALLIC SALTS.

1. CALCIS MURIAS. *Muriate or Hydrochlorate of Lime.*
L. D.—This is a combination of the hydrochloric or muriatic acid and lime. It can be readily procured by the direct union

of its components; but it is generally obtained as the residue of the operation for the production of liquor ammoniæ.

The Hydrochlorate of Lime crystallizes in long six-sided prisms, terminated by hexædral prisms. Its taste is acrid, sharp, bitter, and very disagreeable. It is inodorous; extremely deliquescent; and, when exposed to a high temperature, is decomposed and converted into chloride of calcium.

Hydrochlorate of Lime, in this view of the salt, is a compound of—

Hydrochloric Acid	. 48.10	or	1 prop. = 37
Lime, Oxide of Calcium	51.90		1 prop. = 28
Water	. . . 00.00		5 prop. = 45
	<u>100.00</u>		Equiv. 110

This muriate, when exposed to a strong red heat, is converted into *Chloride of Calcium*: which consists of—

Calcium	1 prop. = 20	or 35.71
Chlorine	1 prop. = 36	64.39
Equivalent	<u>56</u>	<u>100.00</u>

It is again restored to the state of Muriate when it is dissolved in water.

As a medicinal agent, the Muriate of Lime is a Tonic of some power. It is taken into the circulation. It is given in cases of scrofula and enlarged glands, as a deobstruent; but its effects undoubtedly depend on its tonic influence, in which the glandular system shares, in conjunction with the rest of the body. It is said to have succeeded in bronchocele when iodine failed*. Its use in these diseases was first suggested by Fourcroy, in 1782; and, afterwards, its powers were investigated by Dr. Beddoes and Dr. Pearson; and my own experience has enabled me to recommend it with confidence. As it can be combined with the permuriate of iron, it is advantageously prescribed with that chalybeate salt, in languid states of the female habit, with a tendency to bronchocele or other glandular swellings. I have applied the iodine ointment externally, whilst the patient was taking the Hydrochlorate of Lime internally, with seeming advantage. It may be administered, also, in conjunction with *pure ammonia*. It cannot be combined in prescriptions with

* Med. Rep. vol. ii, p. 383, New Series.

the protosulphate of iron, or the carbonates of the alkalies : in the one case an insoluble sulphate of lime, in the other a carbonate of lime, is formed ; both of which are useless. The dose of the saturated solution is from m. xii to fʒii, given twice or three times a day, in infusion of gentian root, or any other simple bitter. In large doses it excites nausea and vomiting ; and this sometimes follows small doses. This effect is relieved by opium. Lisfranc asserts that he has found it highly serviceable as an ointment in ulcerated chilblains, in which it also acts as a stimulant Tonic*.

2. POTASSÆ CHLORAS. *Chlorate of Potassa*.—This salt is prepared by passing Chlorine, extricated from a mixture of eleven parts of muriatic acid and five of black or peroxide of manganese, through a concentrated solution of subcarbonate of potassa in a Wolf's apparatus. In this operation, the hydrochloric or muriatic acid is decomposed : the chlorine passes over in a gaseous state, whilst the hydrogen, uniting with 1 prop. of the oxygen of the peroxide of manganese, reduces it to the state of a protoxide, and forms water. The Chlorine thus given over, when it passes into the solution of the alkali, decomposes a portion of the water, the elements of which, the hydrogen and the oxygen, unite to separate portions of the Chlorine, the former producing muriatic, the latter, chloric acid. Both these acids combine with the alkaline base of the Carbonate of Potassa, and expel the carbonic acid ; thus forming two distinct salts—a chloride and a chlorate. This latter salt is produced in white, pearly, hexhædral plates, soluble in fifteen parts of water at 60° Faht., and two parts and a half of boiling water, from which it is deposited in cooling. The Chlorate of Potassa is inodorous, has a cool, austere taste, not unlike that of nitre ; and, when heated to redness, gives out more than a third of its weight of oxygen gas, leaving in the retort a simple chloride of potassium. According to Robiquet, the whole of this oxygen is not abstracted from the decomposition of the *Chloric* acid ; but one fifth is from the *Potassa*, which is reduced to the metallic state, in order to unite with the chlorine and form a chloride.

* See Revue Med. Feb. 1826.

Chlorate of Potassa contains no water of crystallization : it is a compound of—

Chloric Acid	1 prop. = 76	or	61.228
Potassa	1 prop. = 48		38.772
Equivalent	124		100.000

As a remedial agent, the *Chlorate* of Potassa operates as a stimulant Tonic, by imparting oxygen to the system from the decomposition of the salt in the body ; and thence it was, at one time, employed in the treatment of syphilis and sea-scurvy. In what part of the system the decomposition is effected is not easily ascertained : but as the Chloride of Potassium itself is a Tonic, the influence of the Chlorate is not altogether dependent on the extrication of the oxygen : its use, therefore, is chiefly indicated in those states of the habit in which the powers of the system require to be roused, and, at the same time, a permanent tonic effect to be obtained ; as, for instance, in the sinking stage of typhoid fever ; particularly in that attended with eruptions, as, for instance, malignant small pox and scarlatina. As a remedy in syphilis, it has fallen into disrepute. The dose is from gr. vi. to ℥i in solution, three or four times a day.

3. ARGENTI NITRAS. *Nitrate of Silver*. L. E. D. Syn. *Lunar Caustic*.—This Nitrate is readily prepared by acting upon silver by means of nitric acid diluted with three times its weight of water : the metal is oxidized at the expense of a portion of the acid, and then dissolved in the remainder.

Nitrate of Silver, in its crystallized state, is in brilliant plates, in general very irregular in their forms. They are colourless, inodorous, have an extremely bitter, caustic taste ; stain the cuticle black ; and dissolve in their own weight of water at 60°, and in alcohol. The crystals of Nitrate of Silver are permanent in the air ; and, when the Nitrate is pure, and the water also pure distilled water, no decomposition takes place : but the smallest portion of animal or vegetable matter causes it to become dark-coloured when exposed to light. When these crystals are heated to 426°, they melt, and in this state the salt is run into moulds or *Lingotures*, as the French term them, and is thus formed into cylinders, for the convenience of using it as an escharotic in surgery. These

cylinders, or *lunar caustic*, when pure, are whitish ; but, like the crystals, become dark when the moulds are oiled.

Nitrate of Silver is precipitated from its solution by lime water, and the muriates and carbonates of alkalies. Water, therefore, containing these, which is the case with all hard waters and river water, should never be employed in prescriptions with Nitrate of Silver. It is also decomposed and precipitated by sulphuretted hydrogen and the alkaline sulphurets ; by borate and phosphate of soda ; and by tincture of iodine : all of which are, therefore, incompatible in formula with Nitrate of Silver.

Nitrate of Silver is a compound of—

Nitric Acid	1 prop. =	54 or 68.61
Oxyd of Silver	1 prop. =	118 31.39
Equivalent		172 100.00

Nitrate of Silver communicates general tone to the habit, through the medium of the nerves of the stomach, upon which its primary action is exerted ; but it is also absorbed and taken into the circulation—a fact demonstrated by the leaden hue which it sometimes communicates to the skin of those who take it. Although it operates as a powerful escharotic when applied to the surface of the body, yet the vitality of the stomach is sufficient to resist its chemical influence : its dose may be carried to the extent of even five grains, three times a day. The best mode of administering it is in the form of pills, made up with crumb of bread. It is always advisable to preface its use by emptying the stomach and bowels ; for when much acid, either muriatic or acetic, exists in the alimentary canal, it is decomposed and rendered inert. No salt food, nor much salt, should be used by persons taking the Nitrate ; as these form an inert chloride of silver in the stomach.

When Nitrate of Silver has been overdosed, its injurious effect on the stomach may be counteracted by diluting freely with salt and water, so as to decompose the Nitrate and render it inert : but if there be time for inflammation to be induced, then the case must be treated in the same manner as inflammation of the stomach.

Nitrate of Silver was early employed as a tonic, in the

treatment of disease ; but, from want of due precaution in its administration and the harshness of its operation, it fell into disuse. It was reintroduced by Dr. Simms, of London ; who employed it in the treatment of epilepsy ; and from his success it became much used. In looking at its value in this disease, truth obliges me to say that, except in protracting the return of the paroxysms in symptomatic epilepsy, little is to be expected from its employment. In chorea, however, its merits have not been too highly extolled. It is taken into the circulation, stimulates moderately, and increases the general tone of the habit ; lessening thereby the inordinate irritability and mobility of the system. I have given it also, with great advantage, in angina pectoris.

The dose at first should not exceed one sixth of a grain ; but it may be gradually augmented to four or five grains.

The administration of Nitrate of Silver is productive of one great inconvenience, which stands in the way of its general employment as an internal medicine—it is apt, in some habits, to give an indelible leaden or saturnine hue to the whole skin. This effect does not appear to depend on the quantity of the medicine which is given ; nor does it occur frequently : two questions, therefore, arise—what is the cause of this change of colour of the skin ? and is there any probability of a remedy for it being discovered ? In reply to the first of these queries, if we admit that the Nitrate is taken into the circulation undecomposed, and arrives in that state at the capillaries of the skin, we must also admit that it may be decomposed there, converted into chloride of silver, and deposited in the rete mucosum. The chloride, we know, acquires a grey, leaden colour whenever it remains in contact with animal matter ; and, as it is insoluble, it is incapable of being reabsorbed, is fixed in the rete mucosum, and a permanent stain is given to the skin. This effect, therefore, happens whenever a more than usual quantity of muriates is separated by the cuticular capillaries. With respect to the second query, is there any remedy for this inconvenient effect of Nitrate of Silver ? it must be admitted that none has yet been suggested ; and what I have to propose, being totally unsupported by experience, I offer the suggestion merely as

matter of experiment. I imagine that, by ordering diluted nitric acid, at the time of administering this salt, its decomposition may be prevented: for, although we keep in view the difference between the living system and the laboratory of the chemist, yet it is not improbable that the employment of nitric acid may frustrate the evil by preventing the decomposition of the Nitrate.

As a local Tonic, the Nitrate of Silver has been lately successfully employed in chronic inflammation of the eyes: and to this local influence may be in great part ascribed its utility in affections of the mucous tissues affecting the secreting surfaces, and in ulcerations as recommended by Mr. Higginbottom. It is true that it acts in ulcerations, by forming as it were an artificial cuticle of the part which chemically unites with the Nitrate; but I am inclined to believe that something is also due to its tonic power. On the same principle, it cures that inflammation of the cervix uteri depending on increased irritability of the part.

4. FERRI SULPHAS. *Sulphate of Iron.* L. E. D.—This salt is prepared by dissolving soft iron in diluted sulphuric acid: the water is partially decomposed by the iron, aided by the sulphuric acid, the hydrogen escapes, whilst the oxygen is united with the iron, forming a protoxide, which combines with the sulphuric acid, and constitutes the sulphate. By evaporating the solution immediately, crystals of protosulphate of Iron are obtained; but if it be permitted to remain for some time exposed to the air, it attracts oxygen, and the salt is converted into a persulphate. There are two varieties of the Sulphate of Iron: both are employed as medicinal agents. Protosulphate of Iron has a fine emerald green colour; is transparent, owing to its containing a large quantity of water; and is crystallized in rhomboidal prisms: but the crystals are very irregular. The taste is styptic and nauseous; although neutral, yet, it reddens vegetable blues: is soluble in two parts of cold water and in three quarters of its weight of boiling water; but is again deposited as the water cools. When exposed to the air, it gradually loses its water of crystallization, becomes opaque, and is covered with a yellowish powder, which is a persulphate of the salt: an

effect produced by the absorption of the oxygen of the atmosphere. In solution, this absorption of oxygen proceeds more rapidly than when the salt is in the solid state. The Sulphate of Iron of commerce should not be used for medicinal purposes, as it sometimes contains copper.

The protosulphate of Iron cannot be preserved without changing into the persulphate, unless the bottle be filled with alcohol, in which the salt is insoluble. According to the analysis of Berzelius, it consists of—

Sulphuric Acid	28.9	or 1 prop.	=	40
Iron	25.7	1 prop.	=	36
Water	45.4	7 prop.	=	63
	100.0	Equivalent		139

Both Sulphates, when heated, first lose their water of crystallization, then suffer decomposition; and, if the heat be considerably augmented, are converted into a red powder, called *colcothar*; which is a mixture of red oxide of Iron and the persulphate: a substance formerly employed as a Tonic.

Both Sulphates of Iron are decomposed by the phosphates and the borates, the alkalies and their carbonates, and all the vegetable infusions and decoctions containing tannin. Owing to this great susceptibility of decomposition, the sulphate is generally prescribed in the form of pills, in preference to that of solution. The dose of Sulphate of Iron is from gr. i to gr. x. It acts better in small doses frequently repeated, than in large doses. In large doses it excites nausea. In the dose of ℥i it acts as an emetic.

5. MURIATIS FERRI TINCTURA. *Tincture of Muriate of Iron.* L. E. *Muriatis Ferri Liquor.* D.—The salt of iron in this preparation is a permuriate, which crystallizes with difficulty, and deliquesces on exposure to the air. It dissolves readily in alcohol, forming a permanent reddish-brown solution, or tincture, which has a strong styptic taste; and, owing to the superabundance of muriatic acid ordered in the preparation of the Pharmacopœias, forming with the alcohol an imperfect muriatic ether, it has an ethereal odour. Each drachm of the Tincture contains four grains of the permuriate of Iron. It is decomposed by the alkalies and their carbonates, lime water, and the alkaline earths. It strikes a

deep olive-green colour with infusions of astringent vegetables ; and is thrown down in coagula, when mixed with mucilage of *Acacia gum* : but it may be prescribed in conjunction with infusions of quassia, gentian, and orange peel ; and with tincture of *Calumba*. The dose is from ten to thirty minims, twice or three times a day.

Besides possessing the usual tonic properties of salts of Iron, this solution of the permuriate has the advantage of admitting of combination with the muriates of lime and of Baryta. It displays almost a specific effect in dysury, from spasm of the sphincter muscle of the neck of the bladder, when administered in doses of ten minims, repeated every ten minutes, until the spasm is resolved. Its ordinary dose is from m. x to m. xxx.

6. *FERRI SUBCARBONAS. Subcarbonate of Iron. L.E.D.* The preparation to which this name is attached in the Pharmacopœias is a mixture of the peroxide and the carbonate of Iron. The Protoxide of Iron only forms a definite compound with carbonic acid ; and such a salt is found in nature, under the name of *sparry iron ore*, which contains upwards of forty-two per cent. of carbonic acid ; and, also, in many mineral waters, held in solution by carbonic acid. The carbonate of the Pharmacopœias is prepared by decomposing the protosulphate of iron in solution by subcarbonate of soda : but oxygen is so rapidly attracted from the atmosphere by the precipitate in drying, that it passes into the state of peroxide, and consequently loses its carbonic acid : and no means hitherto devised have been able to prevent this change from taking place.

To render the preparation as perfect as possible, the sulphate of iron should be recently prepared, and in the state of a pure protosulphate. The precipitate should be washed with hot water, and it should be speedily dried between folds of blotting paper.

An imperfect native carbonate of Iron, or rather proto-carbonate, is also naturally formed in every instance when Iron is exposed to a moist atmosphere. The metal is first oxidized, partly by the oxygen of the air, partly by the decomposition of the moisture—a fact which is demonstrated by

the formation of ammonia during the oxidizement, arising from the union of the hydrogen of the water and the azote of the atmospherical air: the oxide thus formed attracts carbonic acid, which is always present in the air, and becomes a subcarbonate or *rust*. In this manner the subcarbonate is ordered to be prepared in the Dublin and Edinburgh Pharmacopœias. A formula is also given for the preparation of the Subcarbonate of Iron by decomposing the protosulphate of Iron—a salt which I shall presently notice—by means of subcarbonate of soda. In this process, a double decomposition takes place: the sulphuric acid quits the protoxide of Iron and unites with the soda; whilst the carbonic acid, set free, attaches itself to the also liberated oxide of Iron, forming with it an insoluble subcarbonate, the sulphate of soda remaining in solution.

To render this preparation perfect, the sulphate of Iron should be recently prepared, or in the state of a protosulphate, as the oxide afforded by the persulphate does not readily combine with carbonic acid. When it is carefully prepared, this subcarbonate, according to Mr. Phillips, should consist of—Carbonate of Iron 40, + Peroxide of Iron 60, in 100 parts. But it is generally so carelessly prepared, that it does not contain more than ten per cent. of carbonate of Iron. It is to the improper manner in which it is prepared that such discordant accounts of the tonic powers of Subcarbonate of Iron are to be attributed, particularly when administered in cases of *tic douloureux*, a disease which has been lately most successfully combated by it.

Subcarbonate of Iron is of a reddish-brown colour, and dissolves with effervescence in acids, yielding up its carbonic acid, which it also parts with at a high temperature. When properly prepared, it is soluble in the juices of the stomach, and is readily taken into the circulation; and, as the carbonate is undoubtedly the active principle, it becomes a matter of great importance that the carbonate should really be the salt administered: and this can always be ensured by making it at the moment it is to be taken. An aqueous solution of eight grains of protosulphate of Iron, mixed with a solution of ten grains of subcarbonate of soda, and immediately swallowed,

will afford a dose of ten grains of protocarbonate of Iron in its most active state ; whereas, a dose of the ordinary subcarbonate contains little more than a grain only of the salt. The dose of the subcarbonate is from ten grains to four drachms.

Besides the artificial preparations of the carbonate and the sulphates of Iron, these salts are found in a state of natural solution in mineral waters in many parts of the world. The springs of Scarborough, Tunbridge, Peterhead in Scotland, Bourbon l'Archambault, Passy, Pongues de Chateau-Gentier, Pyrmont, Spa, Vichi, and many others, contain carbonate of Iron. Those of Sand-rock in the Isle of Wight, of Hartfel in Scotland, and Wals in France, contain sulphate. All these waters are readily distinguished by striking a black or deep violet colour with tincture of galls, and a green, which becomes deep blue on exposure to the air, with ferro-cyanate of potassa. When the water which holds the iron in solution suspends it by means of carbonic acid, a yellow or ochery sediment is precipitated by boiling the water ; and after this operation it ceases to give evidence of its chalybeate nature by the usual tests. When the mineral water contains the sulphate, it deposits no ochery sediment, and answers to the tests as well after it has been boiled as it did before. Both kinds of water may redden the tincture of litmus before being boiled, owing to some free acid being present ; but the water containing carbonate of iron ceases to do this after it has been boiled. If the chalybeate be a sulphate, a precipitate will be formed by nitrate of baryta ; if the sulphate be conjoined with alumina as well as iron, this will be indicated by ammonia. By such means these two chalybeates are distinguished.

7. *FERRI ACETAS. Acetate of Iron. D.*—This is a preparation of little value, although the Dublin College have ordered it to be prepared in two different modes, and to be kept both in a solid form and in that of tincture. It is a mild chalybeate, and may be administered in doses of from eight to fifteen grains to children labouring under scrophulous affections.

TARTRAS POTASSÆ ET FERRI. Tartrate of Potassa and

Iron. L. E. D.—This preparation, which is formed by exposing equal parts of bitartrate of Potassa and filings of soft Iron, mixed together and moistened with water, to the action of the air, is a mixed salt, containing Tartrate of Potassa and a Tartrate of the peroxide of Iron. In this process, the Iron is oxidized at the expense of the water; as a protoxide, which, attracting the oxygen of the air, is changed into the peroxide, and unites with the excess of tartaric acid of the bitartrate.

This mixed salt is of a greyish-green colour, inodorous, and, although styptic, yet not unpleasant to the taste, and is consequently a chalybeate well adapted for children. It is soluble in water, and its solution does not soon undergo decomposition. It has the great advantage of not suffering any change when combined with the alkalies and their subcarbonates; but it is precipitated by the infusions and decoctions of astringent vegetable substances. It attracts moisture from the air, and therefore cannot be prescribed in the form of powder. The dose is from ten grains to half a drachm.

The preparations of Iron, whether those formed by the hand of Nature, or those contrived by the artifice of Man, exert a powerfully tonic effect upon the living system. They increase the digestive powers of the stomach, stimulate the intestines, and, being dissolved also in the gastric and intestinal juices, they are taken up by the absorbents, enter the blood, and stimulate the whole of the system. This is demonstrated by the pulse being rendered stronger and quicker, the heat of the body and thirst being augmented, the countenance rendered more florid, and the whole powers of the system being called into action. It has been denied that Iron is absorbed into the blood; but a series of experiments, detailed in the second volume of the Bologna Commentaries, places the fact of its absorption beyond a doubt. Forty dogs were fed with food mixed with Iron in different states: on killing them, more Iron was found in their blood than in that of the same number of dogs fed in the usual manner; and the quantity varied according to the nature of the Iron employed. Thus, those fed with Iron ore had three times more

Iron in their blood than those who took no Iron with their food: those fed with Iron filings had the next greatest quantity: and those who took the peroxide the least. The cause of these differences is obvious: in the ore, the Iron was in the state of a sulphuret, and easily convertible into a salt in the juices of the stomach, owing to the oxide containing the minimum of oxygen: the Iron filings were not so rapidly rendered soluble; as they had first to suffer oxidizement—a process which could not always be completed before they passed from the bowels: whilst the insolubility of the peroxide readily explains why so little of it is taken into the habit. A very striking proof of the absorption of the salts of Iron is detailed by Dr. Home, Professor of the Practice of Medicine in the University of Edinburgh. On testing the urine of a man to whom he had given a large quantity of the muriated tincture of Iron, with tincture of galls and ferrocyanate of potassa, it afforded evident proofs that it contained a considerable quantity of Iron. But the absorption is slowly effected; and neither the black colour of the fecal discharges, nor the results of testing the excretions, indicates the presence of the Iron for some days after the use of any of the preparations has commenced.

With regard to the medicinal powers of the salts of Iron, the natural chalybeates are of eminent service in all cases requiring tonics: their primary effect is displayed on the digestive organs; whence their influence is propagated, rousing the nutritive faculty in every part of the body: they augment the power of the secretory system; and, by the moderate but permanent nature of the impression which they impart to the nerves, increase the tone and general vigour of all the functions. Something is undoubtedly due to the circumstances connected with drinking mineral waters at their source;—when the cares and anxieties of life have been left behind, in the smoky alley and the crowded street, when Hope and Confidence and Amusement lend their invigorating aid to the tonic influence of the salutary fountain. But tone follows the use of Iron in all its forms, and therefore its preparations are employed in every disease connected with relaxation or debility, particularly of a chronic

kind: dyspepsia, hysteria, amenorrhœa, leucorrhœa, scrophula, and chronic catarrh, are a few of the catalogue of those which chalybeates are calculated to benefit. When salts of Iron are indicated, the doses should be large; but the propriety of giving the large doses of the carbonate which have been lately recommended is questionable. Even in tic douloureux, I have never found it necessary, if the preparation be good, to exceed a drachm for a dose; and, in chorea, I have seen every benefit derived from the regular repetition of smaller doses at short intervals. In a weakened state of the uterine organs, causing a defective secretion of the menstrual fluid, the salts of Iron are productive of the best consequences; but, when amenorrhœa is accompanied with heat in the region of the uterus, pain of the loins, and plethora, they prove hurtful. In both cases, the effects are attributable solely to the tonic influence of these preparations. Reflecting on the chemical characters and medicinal powers of the carbonate, the sulphate, and the muriated tincture, it is evident that they are sufficient for every indication desired from the salts of Iron; and therefore all the other preparations of this metal might be dispensed with and rejected from the Pharmacopœias.

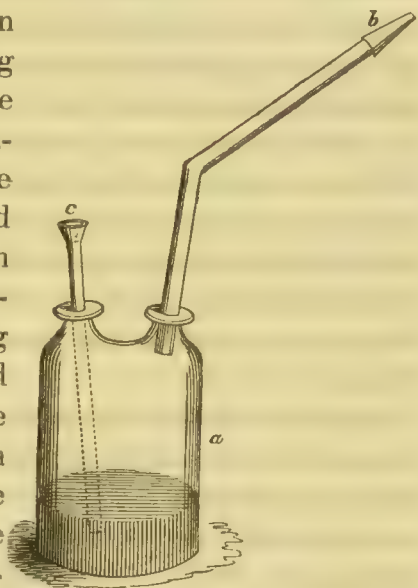
The long-continued use of preparations of Iron seems to predispose to disease by causing an excess of tone; thence those who have thus employed them are liable to inflammation, active hæmorrhage, and similar affections.

q. CHLORINE.

Chlorine operates as a *Tonic*, both in its gaseous state and in combination with other bodies. In the simple state, dissolved in water, it has been advantageously administered in malignant sore throat, in the low stage of confluent small-pox, and in other diseases in which it has been necessary to employ powerful tonic means. The saturated solution, for the preparation of which a formula is given by the Dublin College, has scarcely any colour, a harsh, styptic taste, and exhales the odour of Chlorine: it contains about twice its volume of Chlorine; and may be exhibited in a mixture containing from half a fluid drachm to two fluid drachms in

eight fluid ounces of water, sweetened with a little syrup, which should be taken, in divided doses, in the course of the day.

But a more important application of the tonic powers of Chlorine, discovered by M. Gannal, has been brought into use. This chemist, having perceived that bleachers who employed the chloruret of lime were frequently relieved from threatened symptoms of phthisis, conceived the idea of trying its application, in a highly diluted state, to ulcerated lungs, and obtained a very sensible amelioration of the symptoms. He asserts that it is sufficient to cure such lesions of the lungs as are not absolutely incurable. Its sensible effects are—a greater facility of breathing than the patient enjoys before using it, and an increase of appetite and of strength. The application is made by adapting to one opening of a double-tubulated bottle, *a*, a bent tube with an ivory mouth-piece, *b*, and introducing into the other opening a small funnel, *c*, closely fitted in a cork, through which the charge of the saturated solution of Chlorine, at a temperature of 90° Faht., is poured. The charge at first should not ex-



ceed ten or twelve minims of the solution; but it may be gradually augmented to a fluid drachm; and thus it may be inhaled twice in the twenty-four hours. If we reflect on the effect of Chlorine gas, in an undiluted state, operating as a powerful excitant, and also reflect on the influence of astringents and excitants on ulcerated portions of the external surface of the body, we shall feel disposed to admit the probable beneficial effect of this powerful agent, mitigated by dilution to the state of a simple tonic agent. In this point of view, if diluted Chlorine, applied to an ulcer of the lungs, can afford to it such a degree of stimulus only as can aid the natural powers of life to effect a cure, there is much reason

for believing that it may prove useful. In my own practice I have found it productive of much comfort to the patient. Three of the compounds of Chlorine are employed as Tonics.

1. SODÆ MURIAS. *Muriate of Soda*. L. E. D. *Common Sea Salt*; in chemical language, *Chloride of Sodium*.—This important salt is found abundantly in various parts of the world: in France, in Switzerland, the Tyrol, Hungary, Transylvania, and very extensively in England. In Spain, near Cordova, there is a mountain of common salt, 500 feet in height and nearly three miles in circumference. The diffusion of this salt is a wise provision of Providence, as it is essential for the health of both vegetables and animals. It excites the energy of the living system of both, when taken in small quantities, increasing the vascular action and the general vigour of the frame: when swallowed in large doses, it proves emetic; and, in medium doses, purgative.

To do justice to the natural history, chemical properties, and therapeutical virtues of this article of the *Materia Medica*, would require more space than can be spared in this work: I will, therefore, confine my remarks to a brief sketch of its chemical properties, and an account of its practical use as a Tonic.

Chloride of Sodium, in the purest state in which it can be procured, is in white, semitransparent, regular, cubical crystals, very slightly deliquescent when exposed to the air, inodorous, with a taste strictly saline, and perfectly free from bitterness. When thrown upon a heated iron plate, it decrepitates, in a greater heat it *melts*, and in very high temperatures is volatilized *unaltered*. It is equally soluble in cold and in hot water, requiring two parts and a half only of its weight for its solution, and it passes into the state of a muriate in dissolving. Its solution continues unaltered till it arrive at a temperature under 28°, when the salt separates from the water in which it is dissolved: thence ice taken up at sea yields fresh water. The constituents of the Chloride are, according to Berzelius—

Chlorine	59.305	or	1 prop. = 36
Sodium	40.695		1 prop. = 24
	100.000		Equivalent 60

As a Tonic, although its powers are daily and hourly before our eyes, in its effects when taken with food or as a condiment, yet Chloride of Sodium is seldom prescribed as an officinal Tonic. In many states of the animal body there is a strong instinctive desire for salt, and this is powerfully exemplified in the habits of quadrupeds who come from the interior of the Continent of America, where there is no salt on the surface, to the sea shore at stated periods to procure it. When this desire can be traced in delicate children, I have seen the greatest benefit derived from the employment of the Chloride of Sodium as a Tonic; and I am induced to ascribe its value as an anthelmintic, or destroyer of intestinal worms, rather to its influence as a Tonic than to any other power it may possess. The best method of prescribing it, in such cases, is to mix from gr. x to ℥i in a glass of port wine, and to give this mixture daily at noon. As a local Tonic, the solution of sea salt is a useful application to old and indolent ulcers. The strength of the solution may be proportionate to the degree of stimulus which the sore requires. Its tonic influence, when applied to the skin, shall be noticed in treating of the tonic effects of cold bathing.

2. CALCIS MURIAS. *Muriate of Lime*. L. E. D.—In its crystallized state this salt may be regarded as a compound of chlorine, calcium, and water of crystallization; for, when the fluid is expelled by heat, pure chloride of calcium remains. On the other hand, when this salt is dissolved in water, a portion of the liquid is supposed to be decomposed, the oxygen of which, uniting with the calcium, converts it into lime, whilst the chlorine is changed into muriatic acid by combining with the hydrogen, and thus a Muriate of Lime is produced. It may be procured either by dissolving white marble in pure muriatic acid and evaporating the solution, or by dissolving the salt which remains after the sublimation of the subcarbonate of ammonia, and straining and evaporating the solution. It crystallizes in large prismatic, aggregated crystals, which retain much water, deliquesce rapidly on exposure to the air, are soluble in $\frac{1}{4}$ their weight of water at 60° Faht. and are also soluble in alcohol. They are inodorous, but have a bitter and disagreeable taste. This salt must not be confounded with

chloride of lime, which is a mere admixture, not a chemical combination of lime and chlorine.

Chloride of Calcium and Muriate of Lime are composed of—

Chloride.			Muriate.		
Chlorine	1 prop. =	36 or 64.29	1 prop. =	36	
Calcium	1 prop. =	20 — 35.71	1 prop. =	20	
Water		00 — 00.00	7 prop. =	63	
Equivalent		<u>56</u> <u>100.00</u>	Equivalent	<u>119</u>	

Both the Chloride and the Muriate are decomposed by the sulphuric, nitric, phosphoric, and boracic acids and their salts, the mineral alkalies and their carbonates, carbonate of ammonia, and the oxalate of ammonia; pure ammonia, however, produces no change upon it.

The crystallized Muriate cannot be employed, owing to its deliquescent character; but the solutions ordered in the Pharmacopœias are frequently and successfully prescribed in schrophulous affections, in combination with simple bitter infusions. It operates by its general tonic influence, exerted first on the stomach, and thence extended to the general system. The dose must necessarily depend on the strength of the solution, but the average dose is from m. x to fʒiv. The dry chloride is mixed with snow to produce a freezing mixture, which lowers the thermometer from + 32° to—50°.

3. ACIDUM MURIATICUM. *Muriatic Acid*. L. E. D. Syn. *Hydrochloric Acid*.

In the ordinary temperature and under the usual pressure of the atmosphere, this acid is a gas, which forms dense vapours by uniting with the humidity of the air.

Muriatic or Hydrochloric Acid is prepared by acting on common salt, chloride of sodium, by an equal weight of sulphuric acid. In this process one proportion of the water of the sulphuric acid and the chloride of sodium are decomposed; the hydrogen of the water unites with the chlorine of the chloride, and forms the Muriatic Acid gas, which is absorbed, at the moment of its formation, by the water in the retort, and, rising with it, is condensed in the receiver, in the form of *Liquid Muriatic Acid*, whilst the oxygen of the decomposed water unites with the sodium, and converts it into an oxide, which fits it to combine with the sulphuric acid

and form a sulphate of soda. In conducting the pharmaceutical operation to obtain medicinal Muriatic Acid, it is necessary to dilute the sulphuric acid before pouring it upon the salt in the retort, to prevent the violent action which takes place when it is used in a concentrated state. Water dissolves 464 times its volume of Muriatic Acid gas to form Liquid Muriatic Acid. In the directions of the different colleges for forming it, those of the Edinburgh College are to be preferred, equal weight of chloride of sodium, sulphuric acid, and water being ordered. The acid is mixed with f̄zviiii of water and cooled, and then poured on the chloride, in a glass retort, the rest of the water being put into the receiver. The sp. gr. of this acid is 1.170. The intention of drying the chloride at a red heat before using it, is to decompose the nitrates which are occasionally found in it.

Liquid Muriatic Acid, when perfectly pure, is colourless, strongly sour and acrid to the taste, and emitting suffocating fumes, which become more opaque when a glass rod, dipped in liquid ammonia, is held over them, owing to the immediate formation of muriate of ammonia. The pure acid, as ordered by the London College, should have a sp. gr. 1.160; it should not, when sufficiently diluted, afford a precipitate with the muriate of baryta. It unites with salifiable bases and forms muriates. It is composed of—

Hydrogen	1 prop. =	1	2.7
Chlorine	1 prop. =	36	97.3
Equivalent		<u>37</u>	<u>100.0</u>

In the acid of commerce, iron is often present, and gives it a yellowish colour; but this is easily removed by distillation, and for medical purposes it does no harm.

Muriatic Acid is a powerful Tonic, and as such is frequently and advantageously employed in typhus and other fevers of a similar type. I can bear ample testimony to its efficacy in malignant ulcerated sore throat, such as is frequently epidemic in the metropolis, both internally used and in gargles, combined with the tincture of capsicum, in infusion of roses. It is an excellent application to the gangrenous ulcers which occur in a spongy or scorbutic state of the gums, and in gangrenous sore throat. It is applied by a

small piece of sponge, fixed on a bougie or piece of whalebone, and, after being soaked, pressed so as to squeeze out of it all the superfluous acid. The sponge is to be conveyed to the ulcers and pressed upon them. The first effect is seemingly to increase the inflammation. Whether the tonic effects of this acid, in these diseases, is to be attributed to the action of the entire acid on the nervous energy, or to its decomposition and the action of the chlorine, I will not venture to determine; although, from the effects of chlorine in its uncombined state, there is reason to lean to the latter opinion. In a concentrated state, Muriatic Acid is a virulent poison.

The dose of liquid Muriatic Acid is from m. x to m. xx in ℥ii of water or any vegetable infusion.

c. TONICS ACTING SOLELY UPON THE NERVES.

* *Material.*

a. COLD BATHING.—It is well known that water applied to the surface acts as a Tonic when its temperature is above 40° or below 70° of Faht. ; and, although it may be applied to a small portion only of the surface, its effects extend first to the whole surface, and then to the entire vascular system: a sensation of cold is immediately felt; but, if the application be transitory, the heat is soon recovered. When any person is immersed in water at 60°, the first effect is a general condensation of the whole body, so that rings fall off, the skin becomes pale and rough, like goose skin, and sometimes there is even a chattering of the teeth. On emerging from the water, however, if sufficient energy of the system exist, a sensation of warmth supervenes, the skin reddens, the action of the heart is increased in vigour, and in a short time afterwards a genial perspiration breaks out over the skin. We explain this by saying, that, when a stimulus is suddenly abstracted from the living system, the facility of excitement is increased, and the slightest excitant produces a greater effect than could have existed before such abstraction. When caloric, therefore, is abstracted from the body, as during the immersion of the body in cold water, the action of the cutaneous and other su-

perficual vessels is lessened, and a less degree of caloric produces greater excitement: thence, the glow and general warmth felt on the returning flow of the blood to the surface; and this continues until the excitability is restored to its natural equilibrium. Tone consists in a due degree of vigour in the muscular system, particularly the heart and arteries: by the reaction, therefore, which takes place after Cold Bathing, tone is, as it were, propagated over the whole system; it is particularly so to the stomach, which first experiences it from the peculiar sympathy of that organ with the surface; the digestive powers are thereby augmented, a tendency even to plethora is induced, and cheerfulness and vigour of mind invariably follow. The reaction which thus follows the immersion of the body in the cold bath is always excited in a degree proportionate to the force of the living powers, and to the intensity of the cause which called it into operation. There is a powerful effort within the body to overcome the sudden and general impression made on the sentient surface; and thence a sudden increase of animal heat takes place, by the impression made on the nervous energy, when the blood, which was suddenly repelled from the surface, again returns to it. It is not, however, the abstraction of heat from the surface, by a cold medium, that produces this reaction; it is the sudden application of the cold medium to a large extent of surface. If a person continue too long in the cold bath, beyond the first effects of reaction, the effort necessary to generate an unusual quantity of caloric in the system tends to destroy the animal powers. Such is the immediate effect of Cold Bathing as a Tonic: let us enquire, a little in detail, into the various modes in which it may be applied, and the effect of each as a curative agent.

Sea Bathing.—Part of the tone is induced by the nature of the medium, the great density of the fluid, and the stimulant effect of the saline particles left on the skin. The equable temperature of the sea would render it available at all seasons were it not for the cold of the atmosphere to which the body must be necessarily exposed. During the immersion in the sea, there is apparently less abstraction of caloric from the body than during immersion in fresh water, and the reaction

which follows continues longer. Dr. Currie immersed two persons at the same time in fresh and in salt water at a very low temperature, for the space of thirty-five minutes: little inconvenience was felt by the individual who used the salt water; but the natural temperature of the other, who employed the fresh water, could not be restored without the aid of friction continued for a considerable time. It has always been a remark of seamen, that in dry weather neither rheumatism nor catarrhs are caught at sea, however frequently the body may be wet with the spray or waves of the sea; and, aware of this fact, Captain Bligh, who traversed an immense tract of ocean, with seventeen of his crew, in an open boat, preserved his companions and himself from these diseases, although they were exposed to frequent rains. He effected this by immersing the shirts and jackets of the seamen in the sea water, and ordering them to be worn in their moist state. This effect of sea water is certainly due to the saline particles which stimulate the skin as the aqueous particles evaporate. Part of the salt water has been supposed to be also absorbed, and to become a source of stimulus to the whole system; but this is an erroneous opinion, and the effect on the surface is propagated to the whole system by that nervous sympathy to which we are forced to attribute the general tonic influence of substances which exert a primary effect on the nerves of the stomach. On this account, the moisture which adheres to the skin, in Sea Bathing, should not be wiped off when the bather comes out of the water; and, for the same reason, when sponging with salt water is employed as a Tonic, the moisture should be gently soaked up with a soft towel, so as to leave the saline particles; and when the person is not very susceptible of the impression of cold, it should not be allowed to evaporate so as to leave a crust of saline matter behind it upon the cuticle.

The fresh-water cold bath is also Tonic, although in less degree than the sea water. Much, however, depends on the degree of temperature at which it is employed. Thus, at 48° and 50°, which is the temperature of most fresh water springs, the degree of cold is too intense to be followed by tone: on the contrary, it acts as a sedative, and is followed by the same

injurious results as too long immersion in any cold medium. Instead of reaction and a glow of warmth being felt over the surface, the immersion is followed by shivering, headache, drowsiness, and the loss of appetite, and general debility. In many persons this effect is the constant result of cold bathing, whether in the sea or in fresh water, even at a medium temperature, that of 60° ; and, therefore, such individuals should either not bath at all, or should fortify the system, before using the bath, by a hearty breakfast, or by taking wine, or by exercise sufficient to warm the body without causing sweating.

The conditions of the body where the cold bath is particularly indicated, are debility in all the powers of the system, displayed by fatigue being induced on any slight exertion, and a weakened condition of the digestive organs; thence its importance as a Tonic, in various chronic diseases, and more especially those usually termed *nervous*, attended with tremors of the limbs, and a listlessness and indolence of the mind, where no visceral disease or organic affections are present. This condition of the habit frequently follows severe and debilitating diseases; and is also a frequent attendant of sedentary occupations, for want of that exercise which is requisite to maintain the activity of the bodily powers. But in describing this state of the body as that which indicates the use of the cold bath as a Tonic, it is necessary to be aware that it requires to be cautiously employed when the powers of the body are too languid to induce reaction. The great object to be fulfilled, to secure the tonic effect of the bath, is to produce this reaction at the expense of as little animal heat as possible; and it is on this account that salt water is preferable to fresh. Whichever is employed, when the patient feels the shock of the immersion very severely, when no glow succeeds it, and when other symptoms appear, indicating that the reaction is not equivalent to the contrary impression on the surface of the body, then the cold bath is invariably productive of harm.

In chronic diseases the cold bath is an admirable Tonic: it increases the animal temperature, which, in these diseases, is generally too low; and, consequently, it strengthens the

moving powers, excites the nervous energy, and imparts activity to the whole frame ; and, in these respects, it is preferable to exercise, in as much as this establishes merely the perspiratory excretion, whereas cold-bathing, exciting the whole circulating system, and also the nervous energy, produces not only a more universal, but a more permanent result. In no disease is the tonic influence of the cold bath more beneficial than in that feverish state which not unfrequently attacks studious men, whose pursuits are of a sedentary kind, require much exertion of thought, and excite a considerable degree of anxiety. In such persons the pulse is generally quicker than natural ; the hands are hot ; the appetite impaired ; the bowels irregular ; and their nights restless : and, when this state has been of long continuance, it prepares, as it were, the way for the worst of all diseases not mortal, confirmed hypochondriasis. Such persons bear cold-bathing well ; and when, at the same time, the mind can be amused and diverted from its ordinary train of thinking, this diseased state readily yields to its powers.

But as the disease I have just mentioned, although attended with indigestion, yet differs from true dyspepsia, so this disease is not benefited by the use of the cold bath. It is not easy to give a satisfactory explanation of this difference between true dyspepsia and the disease to which I have just alluded ; but it has been attempted to be explained by supposing that, owing to the sympathy between the stomach and the skin, every excessive impression on the latter must necessarily cause some disturbance of the former ; and, therefore, as the process of digestion requires a pretty uniform state of animal temperature, where the stomach is weak this state cannot be interrupted with impunity. But, although this explanation is satisfactory, as far as regards dyspepsia, yet, it does not clear up the reason why the cold bath is useful in the disease of the studious referred to, and nevertheless is injurious in true dyspepsia.

In some other diseases which require tonic and stimulant remedies, cold-bathing is hurtful : such is the case in chlorosis, a disease of young females, attended with an obstructed state of the menstrual discharge ; in which, although steel

and other tonics are indicated, yet cold-bathing is found to be detrimental, and to increase headache and the chilliness and languor which always attend such a state of the habit.

The term cold-bathing, besides implying the immersion of the body, also comprehends the use of the *shower bath*. This is equivalent to the effusion or dashing of cold water over the body; but, as a Tonic, it is employed in the same diseases, and at the same temperature as the cold bath, in which the body is immersed. In intermittents it has been found useful in breaking the morbid catenation of symptoms which constitutes the disease, when employed a quarter of an hour before the paroxysm is expected to make its attack; and it is more efficacious in such cases if salt be added to the water.

In weak and delicate frames of body, such as often present themselves in females, I have seen much advantage derived from the long-continued use of the shower bath, throughout the year: but, in such cases, it is necessary to begin with water at a higher temperature than that of the atmosphere at the time.

b. EXERCISE.

When we contemplate the number and power of the moving organs of the body, under the controul of the will; the strength of the extensor and flexor muscles, and the facility with which, by their aid, locomotion is produced; few arguments are required to convince us that a state of constant rest is unnatural; and that motion or exercise is essential for the maintenance of health. Exercise, therefore, may be regarded rather as a prophylactic Tonic than one actually adapted for the removal of disease. But, besides the immediate influence which some Tonics exert over morbid actions, the greater number of this class of medicines is employed to restore vigour to the habit debilitated by previous disease; and, in this point of view, Exercise has a claim to the appellation of a direct Tonic. It aids in circulating the blood more equably over the system, promoting especially the action of the capillaries and the function of the skin.

Amongst the various kinds of exercise in general use, *walking* is the best which can be taken when the strength of

the body admits of a moderate degree of fatigue with impunity. It throws into action not only the muscles of the lower limbs, but those of the arms and several of the largest and most important of the trunk ; particularly those which, fixed in the loins, serve as flexors to the thighs. It is probable that the motion of these contribute, in some respects, to aid the peristaltic movements of the intestines, and thus to favour that regularity of the excretory function of the abdominal viscera, without which health cannot be preserved. When Walking, in a convalescent, causes difficulty of breathing, palpitation, or pain in the region of the heart, it should be discontinued : but, when it is performed with ease, it should be continued nearly to the point of fatigue, which may be greatly extended by diverting the mind with a succession of new objects, or the conversation of a lively companion.

Horse exercise requires greater powers of muscles than can be expected in early convalescence ; but, as it engages the upper part of the body, and occupies the arms and large muscles of the chest, which influence the motion of the lungs, it is most important as soon as it can be borne. In taking Horse Exercise also, something is due to the extent through which the person passes in the open air, and the absorption of the attention by the scenery ; for experience has demonstrated that the mere horse exercise, such as may be taken in a riding school, or within a limited space of ground, is not so salutary as riding in the open country. As a prophylactic of phthisis, in those predisposed to that disease, riding has been justly extolled ; and, even when the disease has displayed itself, if, as Sydenham remarks, it be “without fever or ulcer,” riding may be regarded almost as a specific ; although we cannot accord in the opinion of Desault, that it tends to break down the tubercles, and to remove the accompanying obstructions in the liver ; nor enter into the views of Salvadori, who directed his patients in the morning to climb some eminence till out of breath and bathed in sweat. I have often witnessed the beneficial effects of horse exercise in frames of body greatly weakened by asthma ; and have seen individuals who were scarcely able to mount on horseback, return from a ride vigorous and alert ; and, by the daily re-

newal of this exercise, rapidly regain a degree of vigour and tone which could scarcely have been anticipated. When Horse Exercise or walking cannot be resorted to, the next best is Carriage Exercise or Sailing: but it must be recollected that scarcely any of the influence of these can be referred to the muscular system.

It is unnecessary to extend these remarks: in concluding them, however, we must caution against carrying the Exercise of convalescents, particularly those who have suffered from acute diseases, beyond certain limits. It may be continued up to, but certainly not beyond the point of fatigue: in attending to this circumstance, also, we ought to be aware that rest is not always the best method of relieving the uneasy sensation and apparent exhaustion which occur after moderate exertion, in some states of the body; for these are often more readily dissipated by changing the nature of the exertion than by actual rest. At the same time, much danger may result from acting too long upon this principle: for, as the mere stimulus of a change must be regarded as purely mental, the exhaustion of the corporeal powers, when the exertion is over, is so great as sometimes to be productive of the most dangerous consequences. The degree of Exercise, therefore, which the body can sustain with impunity, is not always to be regulated by the sensation of the fatigue which it induces, but by closely observing the extent to which the character of the frame, its muscular energy, and the actual powers of the constitution at the time, taken together, authorize its continuance.

c. FRICTION.

Friction may be regarded as a species of exercise, and its effects can be explained on the same principles. To produce a tonic effect, it ought to be brisk, and performed in such a manner as to produce a degree of redness and warmth on the surface, and extended over a large portion of the body. The ancients judiciously employed Frictions after tepid bathing, and aided its influence by the administration of wine and water, during the intervals of the rubbing. On this principle only can be explained the beneficial effects of the

Oriental custom of shampooing, which has been properly introduced into this country. In phthisis, the pains of the thorax are often relieved by friction; and the influence of percussion, which may be considered a variety of friction in chronic rheumatism, has been fully discussed.

It may be rationally enquired, whether any advantage is derived from aiding the friction by stimulating embrocations or oils? If the friction be well performed, and for a sufficient length of time, nothing of this kind is necessary, except to prevent the skin from being fretted; in which case, dipping the hand in dry flour or hair-powder is as useful as the most celebrated embrocation. It is only when a narcotic impression is to be added to the influence of the friction that embrocations are really useful. The same cautions regarding the extent and degree are necessary, as have been stated respecting exercise. How far friction may owe its salutary influence to electrical agency, is a subject well worthy of examination.

* * *Mental.*

The first of the Mental Tonics is Hope: let us enquire in what manner it operates as a Tonic?

A Tonic we know is a stimulus, but of a degree inferior to that which would produce a state of collapse; and that it must be applied in such a manner as shall keep up and render permanent the impression which it is capable of producing. Now, Hope operates in this manner in many diseases. This is particularly illustrated in *Nostalgia*, a disease which is common to the Swiss, the Scotch, and other mountaineers, when in a foreign country, if circumstances occur to awaken those associations connected with the delights and enjoyments of their early years at home. This disorder, which is ushered in by great depression of spirits, melancholy and languor, deep sighing, trembling of the limbs, and other symptoms, not unlike those of phthisis, would prove fatal in a short time, were Hope not lighted up in the mind; and the prospect of returning home placed before the patients to cherish and keep it alive in their minds. Hope, in this instance, operates exactly as a material Tonic; it increases the energy of the heart and arteries;

improves the secretions, particularly that of the liver ; and not only sustains the powers of life, but, like a material Tonic, it fortifies those tissues which are organically affected, in this disease against the morbid action that would otherwise be induced in them, and which would lead to a fatal termination of the malady. That such morbid states occur, has been demonstrated by the post-mortem examinations of Dr. Avenbrucker, who had many opportunities of seeing the disease in the Spanish hospital at Vienna. This physician observed, that, in several persons who died of Nostalgia, the lungs were generally affected ; that some parts of them were adherent to the diaphragm ; and that in other parts they were indurated, or were even more or less ulcerated. 'The tonic effect of Hope in removing this disease is well known ; and is impressively displayed in the following anecdote, detailed by Zimmerman in his " Treatise on Experience in Physic."— " A Swiss, of the Canton of Berne, who studied physic at Gottingen, fancied that his aorta was about to burst ; and, therefore, could not be prevailed on to stir out of his chamber ; but longed anxiously to return home. About this time, his father sent for him home, and then he ran all over Gottingen with the greatest joy and alacrity, and took leave of all his acquaintance ; whereas, two days before this, he was hardly able to get up a little staircase without being in danger of suffocation." In this case you may remark that the disease was purely imaginary ; and, therefore, that the hope of again returning home was likely to dispel the illusion ; but ample experience has demonstrated that Hope acts as a real Tonic, and is a powerful agent in the hands of a judicious physician.

If two physicians treat the same disease with similar remedies, and with equal skill in their application ; yet, if one of them look grave and anxious before his patient, and drop hints that some uncertainty is connected with the result of the disease ; whilst the other holds up to his patient the prospect of recovery, assumes a cheerful and confident expression of countenance before him, veiling every doubt that may hang upon the future, and directing the eye of the sick man to every enlivening ray that beams upon it ; the certainty

of success is more likely to follow the treatment of the latter than the former of these practitioners. "In dangerous maladies," says an able physician, "the person in whom there is the least fear of dying, has, other circumstances being the same, the fairest chance to survive;" and in this manner, Hope, aiding the efforts of Nature, gives an efficacy altogether unexpected to the application of art.

" 'Is there no hope?' the sick man said ;
The silent doctor shook his head,
And took his leave with signs of sorrow,
Despairing of his fee to-morrow ; *"

and well he might ; for if the countenance be an index of the mind, such an expression in the look of a physician, on whose skill a patient confides, would be the death warrant of his hope of recovery, and consequently the precursor of his dissolution. "Tell a timorous man, who has been in the habit of looking up with reverence to the opinion of his physician, that he is in danger, it may not improbably kill him. Let the doctor pronounce the sentence, with sufficient decision and solemnity, and under certain circumstances it will execute itself." In every case, therefore, in which Tonics are admissible we may take advantage of Hope, as an exciting agent, which tends to increase the power of others upon the system, and which, when *properly applied*, rarely disappoints our expectation. I have put an emphasis upon the words *properly applied* ; for, sometimes, like every other cause of excitement, that produced by holding up the hope of recovery is injurious ; and the favourable termination of serious disease is often aided by a pacific indifference in the patient with regard to the ultimate result.

2. *Confidence*.—On the same principles as Hope, Confidence operates as a tonic power ; nothing is, therefore, of greater importance to the practitioner than securing the confidence of his patient, in order to insure the success of his practice : how is this to be effected ? The first step for obtaining the command of so powerful a weapon against disease, is the acquirement of a thorough knowledge of our profession ; that we may be able to push our enquiries in such a manner

* Gay.

as to convince our patients that we are masters of our art ; for nothing characterizes more strikingly the able physician than his mode of investigating the causes of disease. An inquisitive physician, who examines minutely into the usual habits, the exercise, regimen, sleep, and state of excretions, or whatever in any degree can have contributed to alter the health of the patient, as well as the state of the functions of the body itself, in such a manner as demonstrates an intimate acquaintance with his subject, is certain to attain that controul over the mind of his patient which alone can secure his confidence both in himself and in the means which he employs ; and, having done so, like an intelligent general, who knows the value of his troops, he can rely with security on the results of the measures which he adopts. As a tonic power, the influence of Confidence might be illustrated by a thousand examples: for instance, the empiric owes to it the few cures which he blazons forth as the recommendation of his nostrum ; but, although it is the prop of the impostor, yet, like the dew of Heaven which falls equally on the just and the unjust, it is not the less valuable when properly applied by the scientific practitioner.

Were any thing requisite to prove the power of mental Tonics in disease, it would be only necessary to refer to their influence in sustaining the body under fatigue which could not otherwise be borne. What is it but Hope and Confidence which enable a mother, night after night, to watch at the bed-side of a sick infant ?—to bear up, even with a weak and delicate frame of body, under fatigues which no stranger could sustain, and yet, if the object of her solicitude recover, to suffer no inconvenience from the exertion :—take away the tonic powers of Hope and Confidence, or let all her attentions prove unavailing and her infant fall a victim to the malady, then her health will give way, she will feel the exhaustion which naturally follows exertions too powerful for the strength of her body to sustain with impunity, and fall a victim of the anxiety and watching, under which Hope and Confidence had so long borne her up, and which could alone sustain her by their tonic powers. Nothing can exceed the truth, as well as the beauty, of the passage in Milton's de-

scription of the lazar house, in which the greatest evil is the absence of Hope.

A lazar house it seem'd, wherein were laid
 Numbers of all diseas'd, all maladies
 Of ghastly spasm, or racking torture, qualms
 Of heart-sick agony, all feverous kinds,
 Convulsions, epilepsies, fierce catarrhs,
 Intestine stone and ulcer, colic pangs,
 Demoniac phrenzy, moping melancholy,
 And moon-struck madness, pining atrophy,
 Marasmus, and wide-wasting pestilence,
 Dropsies, and asthmas, and joint-racking rheums.
 Dire was the tossing, deep the groans ; Despair
 Tended the sick busiest from couch to couch ;
 And over them triumphant Death his dart
 Shook, but delay'd to strike, though oft invoc'd
 With vows, as their chief good and final hope*.

Despair, indeed, in every instance where disease falls upon mortality, may be regarded as bearing the standard in the van of Death.

3. *Travelling* is also a mental Tonic ; but it has a closer affinity with material Tonics than either Hope or Confidence. It is an undoubted fact that, however it is accomplished, the mind is so formed that certain impressions produced on our organs of sense, by external objects, are followed by correspondent sensations. Now, in what other manner does a material Tonic produce its effect, except that the sensation is communicated through the nervous extremities of the sentient organs of the stomach or of the skin, instead of those of the eye. The great advantage of Travelling, therefore, is the constant change of the excitant, the repetition of the salutary impression before its effect is dissipated, until, as in the administration of a material Tonic, the effect become permanent. In no disease is the advantage of the Tonic influence of Travelling more conspicuous than in Hypochondriasis. In this disease there are languor and torpor of the whole body, timidity and depression of the mind, and a general disordered state of the functions of the stomach and intestines. Medicines have little influence in relieving these symptoms ; but by a change of climate and of scene the disease is mitigated,

* Paradise Lost, book xi, line 478—493.

and often cured: the question then arises, to what is this to be ascribed? Something, undoubtedly, is due to the state of the atmosphere, the temperature, and other physical properties, which distinguish one climate from another. In a dense atmosphere, for example, more oxygen exists in a given quantity of air, and this may increase the stimulant power of the heart; in a cold climate, however, the blood circulates more slowly through the lungs, and, therefore, the greater quantity of oxygen inhaled in a given time will go for nothing: the beneficial effect of a change from a colder to a more genial climate in Hypochondriasis may, in some degree, be attributed to physical causes; but much more advantage is procured by moving from place to place, than by remaining stationary even in the most favourable climate; and undoubtedly, in this case, the salutary effect can only be ascribed to the mental excitement produced by the constant change of scene.

It may be argued, that the depression of the mind in Hypochondriasis, as it depends on a weakened state of the digestive organs, should be removed by whatever gives tone and vigour to these parts, independent of mental impressions. But this mode of reasoning is more specious than solid: many examples occur in which these organs are greatly diseased, and yet no Hypochondriasis follows; there is, therefore, some state of the nervous system which may suffer greatly from disordered functions in particular organs, but which, as it cannot be regarded as depending on these derangements, so it cannot be removed by their removal. Some predisposition must exist in the nervous system, or in the mind itself, before such functional disorders can produce Hypochondriasis. We know that no set of men are so liable to this disease as scientific and literary men. This has been attributed to their sedentary habits; but much is due, also, to the excitement which they experience being unvaried; as the disease most frequently occurs in those who turn their attention into one line of investigation; or to the prosecution of one branch of science. We know well the force of habit when the abuse of material excitants has been long indulged in; as, for example, opium; and the little impression which, in such cases,

even the largest doses produce on the nervous energy : in the same manner, the constant application of the same mental excitants ceases to rouse the energies of the intellectual principle ; and the body suffers in the general apathy which follows—the motion of the blood languishes ; the surface is deprived of its requisite supply ; the stomach and the intestines, from a consent of these with the state of the mind, are debilitated ; congestion in the arterial trunks, and on the larger vessels succeed, and Hypochondriasis is firmly established. It is not wonderful, under these circumstances, that the functions of so important a gland as the liver should be disordered ; and thence we find that the most common accompaniment of Hypochondriasis is an imperfect and improper formation of the bile. It is true that this disease is sometimes the effect, not the cause, of such a vitiated secretion ; but the same circumstances which operate in the production of the one, are likely to influence the other. If this account of the disease be correct, it is evident that the torpor of the mind may, at least, be regarded as a great part of the malady : whatever, therefore, can produce new impressions adequate to excite the attention, must prove useful ; and excitants of a mental kind, even although at first irksome and troublesome, yet, if they be sufficient to occupy the attention and to lead to a new series of ideas, cannot fail to prove beneficial. It is on these grounds that Travelling operates as a Tonic in Hypochondriasis ; and even in all diseases of debility, if the fatigue be apportioned with judgment to the power of sustaining it. In prescribing Travelling as a Tonic, it is surely unnecessary to say, that countries ought to be recommended most fertile in those circumstances which are likely to rouse the curiosity and arrest the attention. “ Cœlum,” to use the words of the most elegant of the writers of modern medical latin, “ patrio pulchrius, mores festiviores, et scænæ novæ et amoenæ, mentem grate occupant, et imaginationem suavisime detinent*.”

Having dilated so much on the effects of Travelling as a Tonic, it is unnecessary to enter into any details on the tonic influence of *Amusement*. It is the application of the same

* Gregory De Morbis Cœli Mutatione Medendis Diss. Inaug.

causes, under different circumstances, which produces the benefit, and affords, from the nature and repetition of the means, that degree of excitement which is necessary for rousing the energies and drawing forth the powers of the system, without inducing exhaustion.

Therapeutical Employment of Tonics.

Enough has been said in the account of the substances contained in this class of medicines, to demonstrate their importance as remedial agents. In deciding upon their employment, three things require to be attended to:—1. The choice of the Tonic is of great importance; for although all Tonics necessarily possess the same kind of powers, yet, these differ in degree: some are also more acrid and astringent than others; some owe their efficacy to the presence of certain alkaline principles, and some to bitter extractive or to volatile oil modified by combination with other vegetable constituents. We must, therefore, determine how far these principles are likely to fulfil the indication for which the 'Tonic is to be prescribed, before selecting it. 2. The dose. It is important to regulate the dose of the 'Tonic employed, in order to meet the demand which is required, or not to exceed the impression which can be sustained: if it be inadequate to the effect anticipated, the therapeutical indication will remain unfulfilled, and disappointment necessarily ensue; if it be too great, instead of tone, excitement and collapse may be the result. 3. The mode of administering the medicine must be duly considered. If a powerful impression is intended to be made on the stomach, the medicine selected ought to be administered uncombined with other substances, and in such a dose as will produce an impression both powerful and durable: if, on the contrary, the object is to introduce the medicine into the system, it ought to be associated with such substances as will favour its absorption, and to be administered in small and frequently repeated doses.

With respect to the peculiar diseases in which Tonics produce salutary effects, in none are these more conspicuous than in affections of the digestive organs. The efficacy of Tonics in these diseases is well established: their action upon

the gastric nerves is communicated to the encephalon and spinal marrow, and the reaction of these upon the stomach awakens its powers and augments the activity of the digestive function. In selecting the Tonics to be employed, those which contain bitter extractive—for example Quassia, Gentian, or Calumba—are to be preferred: the pure bitter which these substances contain, devoid of astringency, acts in a milder manner than those which contain also gallic acid, tannin, or the alkaloids. Bitters have, likewise, been found efficacious as vermifuges. The Tonic influence which they exert on the digestive organs alters that condition of the mucous membrane which favours the generation of intestinal worms; whilst, at the same time, some bitter substances operate as direct poisons to these parasites.

Although it is scarcely necessary to state that Tonics are injurious in all inflammatory states of the chest, yet, when the mucous secretion is exuberant, as in chronic catarrh, Tonics are decidedly indicated: in these cases the *Cetraria Islandica*, the lesser Centaury, and cinchona, are to be preferred to the other bitters. In hydrothorax, and in all serous accumulations within the thorax, however, they are useless; even when these states are the sequel of asthma and similar affections, in which Tonics exert an undoubted beneficial influence. In conditions of the cerebro-spinal centres producing epilepsy or hysteria, symptomatic of morbid states of the circulating system—for example, hypertrophy of the heart, or of the digestive organs, in connection with hypochondriasis or melancholia—Tonics are likely to produce a salutary change; but, when these diseases depend on morbid conditions of the brain and spinal marrow themselves, then no advantage can be anticipated from the use of Tonics. In some convulsive affections—as, for example, chorea—Tonics may be regarded as the only remedies to be relied upon. Whatever can improve the condition of the digestive organs and re-establish the assimilating power of the system, is likely to alter that state of the urinary secretion which constitutes diabetes; thence the important influence which Tonics exert in that disease; but, at the same time, it must be recollected that, if the symptoms can be traced to any organic affection of the lumbar portion of the

spinal cord, it will be vain to anticipate advantage from the employment of this class of medicines.

In cutaneous affections, not symptomatic of peculiar febrile states, Tonics prove useful ; and this is especially the case when these eruptions are connected with depression of the general powers of the habit manifested by a pallid or discoloured skin, a disordered state of the stomach, emaciation of the body, and a sluggish condition of the bowels. In such a state of the habit the more active Tonics, in particular arsenic and the metallic salts, are especially indicated. It is scarcely necessary to remark that, in scurvy, the only antiscorbutics to be relied upon are Tonics.

But it is in fevers that the efficacy of Tonics is most conspicuous. In simple fever they are rarely required, and in complicated cases the proper time to administer them is a matter which requires great judgment and nice discrimination. As a general rule, their employment should be deferred whilst any obvious local disease exists in the bowels ; although, even under such circumstances, when there is a necessity for supporting the system, they have been productive of the best results. When ulceration of the bowels occurs, it is perhaps better to permit the prostration of strength, which invariably accompanies such a state, to proceed for some time, until evident symptoms of collapse begin to shew themselves, before prescribing Tonics: "for," as Dr. Bright has justly remarked, "when administered too soon, they frequently kindle the inflammatory action with redoubled violence, and then it is that the most appalling combination of debility and nervous excitement is seen for one or two days to precede death." In such cases, also, when they are actually indicated, those substances which are purely tonic and as little stimulant as possible should be selected.

In typhus fever, the indiscriminate use of Tonics has been productive of much mischief. The appearance of languor and debility is no reason why Tonics should be prescribed ; as, in these instances, they have been found to increase all the symptoms, without improving the tone of the habit. The statement of Dr. Clark's experience of the advantages derived from cinchona in every stage of fever, is at variance

with this opinion: but ample experience has demonstrated that it is only after the febrile symptoms have been wholly subdued, when the patient does not rally, and strength is too slowly recovered, that Tonics are beneficial. Under certain circumstances, however, they may be required, even during the continuance of the disease. Thus, when petechiæ appear, whilst the pulse is soft and compressible, and if there be a tendency to gangrene, not only Tonics but stimulants are indicated: in such cases, much advantage is obtained from a combination of volatile oil, as an oleo-saccharum, with sulphate of quinia and sulphuric acid; or, if the vegetable infusions be preferred, we should select those of *Serpentaria*, *Cascarilla*, or *Cusparia*.

After what has been stated respecting the value of *Cinchona* bark, as an antiperiodic medicine in intermittents, it might be supposed that little remains to be said regarding the employment of Tonics in these fevers; but it is necessary to guard the student and the inexperienced practitioner from being misled by too general a view of this subject. If the intermissions be imperfect, and any local inflammation exist, much caution is requisite in prescribing Tonics; and, in every instance, a complete state of apyrexia in the intervals should be procured by other means before venturing upon their employment. It is essential, however, to discriminate between local inflammation of the viscera and those engorgements of the spleen and of other parts, which exist in persons who have suffered from long-protracted agues, and which are generally aggravated by any fresh attack of the disease: the presence of these need not interfere with the use of the bark or arsenic. It has been asserted that the latter of these Tonics may be administered even during the existence of inflammatory symptoms; but, upon this point, I must confess that I am sceptical. In some peculiar modifications of inflammatory action—such, for example, as occur in chronic rheumatism—arsenic may be administered; but the salts of quinia, the *Menyanthes*, and other Tonics, are equally safe and useful. In cases of intermittents complicated with affections of the brain or the thoracic or abdominal viscera, Tonics ought not to be

resorted to until the local affections are subdued in intensity, if not wholly removed. But, where the paroxysms return with much severity, and are likely to be productive of danger in weak constitutions, it would be improper to delay the use of Tonics; for, the local affection often owes much of its aggravated character to the impression made by each recurring paroxysm. In such cases, however, the least stimulating Tonics should be selected; such, for example, as Quassia and Calumba.

In remittent fevers, the utmost caution should be observed in prescribing Tonics. The remission should be complete, or rather the disease should be transformed into the intermittent type, before they can, with propriety, be employed: indeed, nothing is so likely to change a remittent into continued fever as the injudicious employment of Tonics. In infantile remittents, notwithstanding the high authority of Dr. Clarke, of Newcastle, who, in his work on fever, recommends bark to be immediately resorted to, after the administration of an emetic, I accord with those who delay the use of Tonics until the advanced stage of the disease, when it proves obstinate: then the Cascarilla, which is generally preferred in such cases, maintains the tone of the stomach and bowels, and enables us to proceed with the alterative and purgative plan of treatment. I have already mentioned the circumstances under which Cinchona and other Tonics are likely to prove useful in hectic; but, in this modification of fever, it must be confessed that little reliance is to be placed upon any class of medicines.

Upon the whole, it is necessary that Tonics should not be confounded with Stimulants; and, although it is proper to prescribe them with caution in any form of fever complicated with local inflammation, yet, we ought not to be prevented by the dread of inflammatory symptoms from employing a class of remedies so well calculated to restore the strength and vigour of the nervous system essential for carrying on the functions of life: we must always recollect that tone is not excitement, nor strength increased vascular action.

LONDON:
PRINTED BY J. MALLETT, 59, WARDOUR STREET,
SOHO.





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